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The Engineer

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PUBLIC NOTICES

TENDERS.

The Commissioners of His Majesty's Works, &c., are prepared to receive TENDERS before 11 a.m. on Wednesday, 4th March, 1925, for the SUPPLY of VALVES, GLAND COCKS, &c.
Forms for Tender, &c., may be obtained on application to the CONTROLLER OF SUPPLIES, H.M. Office of Works, &c., King Charles-street, Westminster, London, S.W. 1. 8423

The Director - General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for :—
1. ACCUMULATORS FOR TRAIN LIGHTING.
2. BOILERS FOR LOCOMOTIVES.
3. LANCASHIRE OR CORNISH BOILERS.
4. BRIDGE WORK.

Tenders due on the 3rd March, 1925, for No. 1, on the 10th March, 1925, for No. 2, on the 17th March, 1925, for No. 3, and at 10.30 a.m. on the 26th March, 1925, for No. 4.
Tender forms obtainable from above. 8441

Civil Engineer Required by the GOVERNMENT of the GOLD COAST for the Lay-out of the Takoradi Township, for a tour of not less than 12 nor more than 18 months' residential service in the first instance. Salary, £480 for the first three years of service, then £510, rising by annual increments of £30 to £720 a year, and thence by annual increments of £40 to £920 a year (the question will be considered of paying a higher commencing salary than £480 a year to a highly qualified engineer). Outfit allowance of £60 on first appointment. Free quarters and passages and liberal leave on full salary. Candidates, age 25 to 40, must be A.M.I.C.E. or A.M.I. Mun. and Cy. E., or hold equivalent professional qualifications; must be good Surveyors and have had experience in Road Construction, Town Planning and Drainage Works.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, London, S.W. 1, quoting M/13,327. 8442

Civil Engineers (4) REQUIRED by the GOVERNMENT of CEYLON, for three years' service as District Engineers in the Public Works Department. Salary, £500, rising to £960 a year. (A commencing salary of £600 a year will be paid to selected candidates who have attained the age of 31.) Free passages. Candidates, age between 25 to 35, should have passed the examination for Associate Membership of the Institution of Civil Engineers, and have had experience as a Contractor's Engineer on Public Works, or as an Engineer-in-Charge of Work carried out Departmentally. Must be competent in Surveying (Engineering) and Levelling.—Apply at once in writing, giving age, qualifications and brief details of experience, and stating whether married or single, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting clearly at head of application M/13,384. 8417

Civil Engineers (2) REQUIRED by the GOVERNMENT of SIERRA LEONE for the PUBLIC WORKS DEPARTMENT, for two tours of from 12 to 18 months' service, with possible extension. Salary, £480 for the first three years of service and then £510, rising to £720 a year by annual increments of £30, and thence to £920 a year by annual increments of £40. Free passages and quarters, and liberal leave on full salary. Candidates, aged 25 to 35, must have served articles with a Corporate Member of the Institution of Civil Engineers, and have passed the examination qualifying for A.M.I.C.E. or hold equivalent professional qualifications. Must be good Draughtsmen, capable of Designing and Carrying-out Buildings, Bridges and other Engineering Structures, and of taking out Quantities and Preparing Detailed Plans and Estimates. Must be competent to Execute Surveys and to Lay-out and Construct Roads, and have had experience as Civil Engineers on the Construction of Roads, Buildings and other Public Works.—Apply at once, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/13,305. 8418

Section Engineers (4) Re- QUIRED for the CONSTRUCTION BRANCH of the FEDERATED MALAY STATES RAILWAYS for three years' service, with possible extension. Salary 400 dollars a month, rising to 475 dollars a month by annual increments of 25 dollars a month, plus a temporary non-pensionable allowance of 10 per cent., which is liable to cancellation or revision, plus a commuted field allowance of 50 dollars a month. The exchange value of the dollar in sterling is at present fixed by the Government at 2s. 4d., but its purchasing power in Malaya is at present considerably less than that of 2s. 4d. in the United Kingdom. Free passages provided. On expiration of agreement a bonus of four and a-half months' salary may be allowed, provided the work and conduct of the person engaged has been in every way satisfactory. Candidates, age 22 to 38, unmarried, must have passed examination to qualify for Associate Membership of the Institution of Civil Engineers or hold equivalent professional qualifications, have served an engineering apprenticeship on a home railway and preferably possess some subsequent experience on railway construction or maintenance. In the event of the selection of a candidate who has not attained the age of 26, he will only receive a salary of 350 dollars a month until he has attained that age.—Apply at once by letter, stating age and particulars of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting at top of application M/13,264. 8439

The Government of India REQUIRE the SERVICES of TWO LECTURERS for the TECHNICAL SCHOOL, JAMALPUR, East Indian Railway. Candidates must be conversant with all the usual Mechanical Engineering Subjects, not less than 25 years of age, and hold an Engineering Degree of a British University. They must have had at least three years' practical experience with an engineering firm of repute, and be qualified to teach (for Post 1) Machine Drawing and Design and Applied Mechanics, (for Post 2) Workshop Practice and Heat Engines.
TERMS.—Agreement for three years in first instance. Salary at the rate of Rs. 800, rising by annual increments of Rs. 50 to Rs. 1000 per calendar month. Free first-class passage to India and return passage on satisfactory termination of agreement. The selected candidates will only be appointed subject to satisfactory references and a strict medical examination.
Further particulars should be obtained from the SECRETARY TO THE HIGH COMMISSIONER FOR INDIA, 42, Grosvenor-gardens, London, S.W. 1. Last date for receipt of applications, 28th February, 1925. 8444

PUBLIC NOTICES

Auckland University College, NEW ZEALAND.
APPLICATIONS are INVITED for the POSITION of LECTURER in CIVIL ENGINEERING. Salary £500 per annum. Full particulars obtainable from the HIGH COMMISSIONER FOR NEW ZEALAND, 415, Strand, London, W.C. 2, by whom completed applications will be received up to and including the 31st March, 1925. 8412

Bilston Urban District Council. NEW BRATCH WATER SCHEME.
CONTRACT No. 1.
PUMPING INSTALLATION.
The Council invite TENDERS for the SUPPLY, DELIVERY and ERECTION at the Bratch Pumping Station, Wombourn, Staffordshire, of TWO PUMPING UNITS, complete with Crane, Tanks, Electric Lighting Plant and all works in connection therewith, and for the MAINTENANCE of the whole in thorough repair for twelve calendar months from the certified completion thereof.
The pumps to be of the vertical-spindle and horizontal Centrifugal Types, driven by Oil Engines.
The general lay-out is designed for Vertical Oil Engines, but contractors may submit Tenders and schemes for Horizontal Oil Engines driving the above types of pumps.
Copies of the conditions, specification, general drawings and form of Tender may be obtained on application to the undersigned. The application must be accompanied by the sum of £5, which will be refunded on return of the documents within seven days or after the receipt of a bona fide Tender and the documents required.
Each Tender must be accompanied by drawings and detailed specifications.
Facilities for inspecting the site and general information can be obtained on application to Mr. Edgar Willan, the Engineer and Surveyor to the Council, Town Hall, Bilston.
Tenders are to be sent in on the form supplied, and with the annexed documents must be enclosed in a sealed cover, marked "Tender for New Pumping Plant at the Bratch," addressed to and reaching the undersigned not later than 10 a.m. on Thursday, the 26th of March, 1925.
The Council do not bind themselves to accept the lowest or any Tender.
JOSEPH L. AELIDGE,
Clerk and Solicitor of the Council.
Town Hall, Bilston.
February 14th, 1925. 8380

City of Liverpool. WATER ENGINEER'S DEPARTMENT.
CONTRACTS FOR THE SUPPLY OF MATERIALS, &c.
The Corporation are prepared to receive TENDERS, covering the period of twelve months ending 31st March, 1926, in respect of the MATERIALS, &c., set out in the undermentioned Schedules, viz.:—
1. BRASS CASTINGS AND FITTINGS.
2. CARTAGE.
3. LEAD PIPE.
4. CAST IRON PIPES.
5. MISCELLANEOUS IRON PIPES AND CASTINGS.
6. SLUICE VALVES.

Separate Tender forms, including specification and schedule, for any of the above items will be forwarded upon receipt of application in writing to the Water Engineer, Alexandra Buildings, 55, Dale-street, Liverpool.
Duplicate forms of Tender for record purposes will not be supplied.
Tenders must be sealed and enclosed in the official envelopes provided, endorsed in accordance with the instructions in the form of Tender, and FORWARDED THROUGH THE POST, addressed to "The Town Clerk, Municipal Buildings, Liverpool," so as to be delivered not later than Ten o'clock a.m. on Tuesday, the 3rd March, 1925.
WALTER MOON,
Town Clerk.
8421

PUBLIC NOTICES

Borough of Newport, Isle of WIGHT.
TENDERS FOR SUPPLY, DELIVERY, AND FIXING NEW 12 H.P. BOILER, &c.
The Town Council of Newport, Isle of Wight, invite TENDERS for the SUPPLY, DELIVERY and FIXING of a NEW 12 H.P. BOILER and SEATINGS complete at the Sewage Works, Newport, I.W.
Alternative prices may be submitted for :
(1) Davey-Paxman Economic Boiler,
(2) A Cornish Boiler or Boiler of other type of equal power.

Further particulars may be obtained from Mr. E. A. Slater, A.M.I.C.E., Borough Engineer, Newport, I.W.
Tenders, marked outside "Tender for Steam Boiler," should be sent in to me not later than 4 p.m. on Monday, the 9th March next.
Other things being equal, preference will be given to contractors who are on the King's Roll.
The lowest or any Tender will not necessarily be accepted.
T. ROSS PRATT,
Town Clerk.
Municipal Offices :
38, Quay-street, Newport, I.W.,
18th February, 1925. 8437

City of Nottingham.
The Works and Ways Committee are prepared to receive TENDERS for the SUPPLY of the UNDERMENTIONED STORES and MATERIALS, the contracts to commence on the 1st April, 1925, and to terminate on the 31st March, 1926 :—

A	Cement.
B	Blue Lias Lime.
C	Red Bricks.
D	Blue Bricks.
E	Timber.
F	Stoneware Pipes, &c.
G	Stoneware Pipes, &c. (patent joints).
H	Iron Castings, Iron Gulleys, &c.
I	Yorkshire Flags, Kerb, &c.
J	Granite Setts, Kerb and Broken Granite.
K	Ironstone Slag, Chippings, &c.
L	River Gravel.
M	Concrete Sewer Tubes.
N	Picks, Shovels, Scoops, &c.
O	Ironmongery.
P	Scavenging and other Brushes.
Q	Limestone Chippings.
R	Refined Tar.
S	Pitch.
T	Creosote Oil.

Forms of Tender may be obtained on applying to Mr. T. Wallis Gordon, City Engineer and Surveyor, Guildhall, Nottingham, on payment of a deposit of 5s. each, which will be returned on receipt of a bona fide Tender in accordance with the specifications, providing such Tender is not withdrawn and is delivered by the time stated below.
Patterns and samples may be inspected at the Eastcroft Depot, London-road, Nottingham.
The Committee will not consider any Tender except on the authorised form of Tender, which must be delivered to the undersigned, in the official envelope provided, on or before Thursday, 5th March, 1925.
The lowest or any Tender will not necessarily be accepted, and Tenders will only be accepted from persons who conform to the conditions as regard paying the local standard rate of wages, &c., and to the working rules of the Nottingham District, applicable to the various trades.
By Order,
W. J. BOARD,
Town Clerk.
Guildhall, Nottingham,
11th February, 1925. 8386

Hursley Rural District Council. CHANDLERS FORD MAIN SEWERS.
TO ENGINEERS.
TENDERS are REQUIRED for GAS and OIL ENGINES and PUMPS.
Particulars can be obtained from Messrs. WESTON, BURNETT and THORNE, Civil Engineers, 24, Portland-street, Southampton. 8399

PUBLIC NOTICES

ENGINEERING EXHIBITION.
IN THE DRILL HALL,
Richardson Street,
SWANSEA.
Under the auspices of
The South Wales Institute of Engineers.
From Thursday, August 6th, to Saturday, August 15th, 1925.
(both dates inclusive).
Open each day from 2 p.m. to 8 p.m.

The Council of THE SOUTH WALES INSTITUTE OF ENGINEERS invite APPLICATIONS FOR SPACE in the above Exhibition. The Drill Hall has been booked from August 1st to August 22nd, 1925, so as to allow Exhibitors sufficient time for the erection and dismantling of exhibits.
The Council desire the Exhibition to be as comprehensive as possible, and to include all kinds of machinery and plant used at works and collieries in the neighbourhood of Swansea, covering the many and varied industries of the district; such as Coal, Steel, Iron, Copper, Nickel, Zinc, Spelter, Tinplates and Galvanising; also Docks, Flour Mills, Railways, &c., as well as General Engineering.
Forms of Application for Space, Ground Plan, Schedule of Exhibits &c., will be forwarded on application to
MARTIN PRICE,
Secretary,
The South Wales Institute of Engineers,
Park Place, Cardiff.
8383

Farnham Urban District Council. UNEMPLOYMENT RELIEF WORKS.
CONTRACT NO. 1.
MAIN DRAINAGE.
TO CONTRACTORS.
The Farnham U.D.C. are prepared to receive TENDERS for the CONSTRUCTION of about 7000 YARDS of 12in., 9in., 8in., and 6in. diameter STONEWARE and CAST IRON SEWERS, together with MANHOLES, VENTILATING SHAFTS and other appurtenant WORKS; and also for the CONSTRUCTION of SETTLING TANK, PERCOLATING FILTERS, HUMUS TANKS and other WORKS at their existing Sewage Farm, in accordance with the plans and specification prepared by the Engineer, Mr. G. Midgley Taylor, of Messrs. John Taylor and Sons, Caxton House, Westminster, S.W. 1.
Copies of the specification, bill of quantities and form of Tender may be obtained and the drawings may be seen at the offices of the Engineer upon payment of £5 (cheque only), which will be returned upon receipt of a bona fide Tender.
Sealed Tenders, endorsed "Main Drainage," addressed to the undersigned at his office at Farnham, must be received before Twelve Noon on Saturday, the 21st day of March, 1925.
Any contract or contracts entered into will include the usual fair wages and conditions of labour clause and special conditions as to engaging unemployed men from the local Labour Exchange.
The Council do not bind themselves to accept the lowest or any Tender.
By Order,
(Signed) A. A. MINNS,
Deputy Clerk.
Council Offices,
Farnham, Surrey. 8391

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PUBLIC NOTICES

Metropolitan Water Board.

PROVISION OF 5 TON STEAM CRANE—BATTERSEA.

The Metropolitan Water Board invite TENDERS for the SUPPLY, TESTING and SETTING to WORK of a STEAM-DRIVEN LOCOMOTIVE SHUNTING JIB CRANE of 5 tons capacity at their works in Kirtling-street, Battersea Park-road, S.W.

Tenders must be made on the official forms, which may be obtained on and after Thursday, 19th February, 1925, from the Chief Engineer, Metropolitan Water Board, New River Head, 173, Rosebery-avenue, E.C. 1, by personal application (Room 156) or upon forwarding a stamped addressed brief envelope.

Tenders, enclosed in sealed envelopes, addressed to "The Clerk, Metropolitan Water Board, New River Head, 173, Rosebery-avenue, E.C. 1," and endorsed "Tender for Crane," must be delivered at the offices of the Board (Room 122) not later than 11 a.m. on Tuesday, 3rd March, 1925.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER,
Clerk of the Board.

Offices of the Board,
173, Rosebery-avenue, E.C. 1,
17th February, 1925. 8419

Tyne Improvement Commission.

ELECTRIC MOTORS AND ACCESSORIES.

The Tyne Improvement Commissioners are prepared to receive TENDERS for the SUPPLY and DELIVERY of ONE 20 H.P. and THREE 3 H.P. D.C. ELECTRIC MOTORS for their No. 3 Staith, Whitehill Point, North Shields.

Copies of the form of Tender and specification may be obtained on application to the undersigned.

Tenders, in sealed envelopes endorsed on the cover "Tender for Electric Motors and Accessories," must be delivered at the undermentioned offices, addressed to "The Chairman of the Docks Committee, Tyne Improvement Commission," not later than Noon on Saturday, the 28th day of February, 1925.

The Commissioners do not bind themselves to accept the lowest or any Tender.

By Order,
ALBERT BLACKLOCK,
Secretary.

Tyne Improvement Commission Offices,
Bewick-street, Newcastle-upon-Tyne,
17th February, 1925. 8395

Urban District Council of HAVANT (HANTS).

EXTENSION OF MAIN DRAINAGE WORKS OF HAVANT.
UNEMPLOYMENT RELIEF WORKS.
GENERAL CONTRACT No. 2.

The Urban District Council of Havant invite TENDERS from responsible and experienced contractors for the CONSTRUCTION of the WORKS, which comprise Stoneware and Cast Iron Sewers, Brick, Concrete and Cast Iron Manholes, Cast Iron Rising Main, Underground Pumping Station, Pumping Plant, &c., and other incidental works.

A copy of the specification may be seen and form of Tender and bills of quantities may be obtained on application, in writing, to Major T. J. Moss-Flower, Chartered Civil Engineer, 28, Victoria-street, Westminster, S.W., and Carlton Chambers, Bristol, at his Bristol Office, on and after the 24th February, 1925, on a deposit of a £5 Bank of England Note, which will be refunded, provided a bona fide Tender be received, and is not withdrawn before the sealing by the Council of one of the Tenders, and provided also that all documents supplied be returned to the Engineer. On production of a receipt for the deposit persons tendering may inspect the plans at Havant on a day and at a time and place which will be communicated to them.

The contractor carrying out the work will be required to comply with the regulations of the Unemployment Grants Committee with regard to the employment of labour during the performance of the contract.

Sealed Tenders, endorsed "Tender for Havant Main Drainage Extension, General Contract No. 2," are to be delivered at the Council offices not later than Noon on 14th March, 1925.

The lowest or any Tender will not necessarily be accepted, and the carrying out of the work is subject to the approval of the Ministry of Health and the Unemployment Grants Committee.

Dated this 17th day of February, 1925.

(By Order),
E. R. LONGCROFT,
Solicitor and Clerk to the Council.

Council Offices,
Havant, Hants. 8379

Hayfield Rural District Council.

MELLOR WATERWORKS.

APPLICATIONS are INVITED for the POSITION of CLERK OF WORKS on the Contract for Mellor Waterworks, Derbyshire.

Candidates should have had previous experience in Concrete Construction and the Jointing of Pipes, and must be competent to Set Out Work with Dumpy Level, to Measure Up Work executed, and to keep Record Plans.

Applications, in candidates' own handwriting, stating age, particulars of experience, and salary required, and whether cyclist or motor cyclist, with copies of recent testimonials, to be sent by the 3rd March, 1925, to

F. WALTER HODSON, M. Inst. C.E.,
Consulting Engineer.

Bank Chambers, Loughborough,
17th February, 1925. 8410

SITUATIONS OPEN

WANTED by Well-known Lift Firm, First-class REPRESENTATIVE for London. Must be known to architects and builders.—Address, stating full particulars and terms, P272, The Engineer Office. P272 A

WANTED, MAN of Mature Years as COST ACCOUNTANT in Engineering Works. Previous experience essential.—Address, giving full details, copy of testimonials only should be sent, 8416, The Engineer Office. 8416 A

AGENTS in all Districts REQUIRED by Firm of Eng., dealing in Appliances for Conversion of Hand Hoists to Electric Power.—State full particulars, territory covered, in confidence, to CALDER and PARTNERS, 70, Victoria-street, S.W. 1. P296 A

CENTRIFUGAL PUMP DESIGNER.—An Important FIRM REQUIRE the SERVICES of an EXPERT, to devote his whole time to the hydraulic side of Centrifugal Pump Design.—Address in confidence, giving full particulars, 8327, The Engineer Office. 8327 A

ESTIMATOR REQUIRED, Capable of Making Estimates from project drawings for Mechanical Handling Plants for coal and other materials. Only men with good experience and proved abilities need apply. State age, experience, and salary required.—Address, 8165, The Engineer Office. 8165 A

EXPERIENCED ENGINEER REQUIRED by Large General Engineering Firm (London district), to Assist Chief Inspector. Must have had a wide experience on the inspection of high-class interchangeable parts to close limits and to pass Government Inspectors, both during production and after assembly; must also have been previously employed in a similar capacity.—Address, stating age, salary required, and details of experience in chronological order, 8320, The Engineer Office. 8320 A

SALESMAN FOR PETROL LOCOMOTIVES.—An Important ENGINEERING WORKS REQUIRE an OUTSIDE REPRESENTATIVE for the sale of Petrol-paraffin Locomotives. Applicants must have previous knowledge of this speciality. Good prospects for suitable man. State in confidence full details of experience, salary required, &c.—Address, 8435, The Engineer Office. 8435 A

TECHNICAL STATISTICS.—REQUIRED for Process Operation Statistics, a YOUNG GRADUATE with mathematics as principal subject, to undertake work in the abstracting and interpretation of technical records. Knowledge of graphs and experience with slide rule essential.—Address, 8390, The Engineer Office. 8390 A

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YOUNG METALLURGICAL GRADUATE is REQUIRED for work at University of Sheffield on behalf of British Cast Iron Research Association.—Application should be made to the DIRECTOR, B.C.I.R.A., 75, New-street, Birmingham. 8397 A

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WANTED, CHIEF DESIGNER for Transformer Department of large Electrical Firm. Applicants should state experience and salary required.—Address, 8440, The Engineer Office. 8440 A

WANTED, DRAUGHTSMAN, Constructional, thoroughly experienced in design and working details for Steel-frame Buildings.—Apply by letter, stating age and salary required, to BANISTER, WALTON and CO., Ltd., Trafford Park, Manchester. 8398 A

WANTED, DRAUGHTSMEN, with Good All-round Mechanical Experience, Engines (I.C.), Air Compressors, Hydraulic; London district.—Address, stating age, experience and salary, P299, The Engineer Office. P299 A

REQUIRED AT ONCE for Healthy European Country, HEAD ROLLER for Rail and Structural Mill; one familiar with Flat-bottom Rails; good and comfortable position with prospects for a first-class man.—Address, with full particulars of experience and references, which will be treated in strict confidence, P297, The Engineer Office. P297 A

WANTED, Young CIVIL ENGINEERING DRAUGHTSMAN for permanent post in West minster office.—Address, P274, The Engineer Office, stating age, training, and salary required. P274 A

CHIEF DRAUGHTSMAN.—VACANCY Exists in Engineering Firm in Belfast manufacturing specialities. Capable of handling multiplicity of small contracts expeditiously. Must be good organiser and strict disciplinarian. Staff about 24. Only experienced first-class man will be considered. Replies strictly confidential.—Address in first instance, stating age, experience, and salary required, 8388, The Engineer Office 8388 A

DESIGNING DRAUGHTSMAN REQUIRED in connection with Coal and Mechanical Handling Plants. Only men with complete knowledge and first-class experience need apply. State age, experience, and salary required.—Address, 8166, The Engineer Office. 8166 A

DRAUGHTSMEN.—BEFORE NEGOTIATING with Government Departments in connection with any post, PLEASE COMMUNICATE with the GENERAL SECRETARY, Association of Engineering and Shipbuilding Draughtsmen, 96, St. George's-square, London, S.W. 1. 7871 A

DRAUGHTSMEN (Grade III.) REQUIRED for Aircraft and Engine Work. Candidates must have had good technical training and some works and drawing-office experience.

Ex-Service men preferred. Salary 45s. to 52s. per week and Civil Service bonus, giving present total remuneration 74s. 9d. to 84s. 2d.

Write, quoting A. 48, to SUPERINTENDENT, Royal Aircraft Establishment, South Farnborough, Hants. 8421 A

DRAUGHTSMAN, Having Sound Experience in Steam Turbine Work.—Address, stating age, previous experience and salary required, with copies of references, 8388, The Engineer Office. 8388 A

DRAUGHTSMAN REQUIRED by Engineering Firm in City, used to Piping Lay-outs. Only experienced man need apply. State age, salary, and experience.—Address, 8438, The Engineer Office. 8438 A

DRAUGHTSMEN REQUIRED for Photographic Work.

REF. A. 51.—Grade I. Starting salary £160 a year plus Civil Service bonus (giving present total remuneration of £262 5s.) on the scale £160-10-£200 plus bonus. Candidates must have had good workshop and technical training and at least six years' experience in highest class camera work.

REF. A. 52.—Grade III. Salary between 40s. and 52s. p.w. plus Civil Service bonus, giving present total remuneration of 68s. to 84s. 2d. p.w. Candidates must have had good training and some experience in high-class camera or instrument work. Ex-Service men preferred.

Write, quoting the appropriate reference number as above, to SUPERINTENDENT, Royal Aircraft Establishment, South Farnborough, Hants. 8422 A

DRAUGHTSMEN REQUIRED for Wireless Work.

REF. A. 49.—Grade I. Starting salary £160 a year plus Civil Service bonus (giving present total remuneration of £262 5s.) on the scale £160-10-£200 plus bonus.

Candidates must have had good workshop and technical training and at least six years' experience in telephone, telegraphic or wireless work.

REF. A. 50.—Grade III. Salary between 40s. and 52s. p.w. plus Civil Service bonus, giving present total remuneration of 68s. to 84s. 2d. p.w.

Candidates must have had good training and some experience of telephone, telegraph or wireless work. Ex-Service men preferred.

Write, quoting the appropriate reference number as above, to SUPERINTENDENT, Royal Aircraft Establishment, South Farnborough, Hants. 8420 A

DRAUGHTSMAN WANTED in London Constructional Steelwork Engineers' Office; used to detailing for shops; must be reasonably quick and accurate.—Address, stating age, experience and salary required, and when free, P301, The Engineer Office. P301 A

DRAUGHTSMAN WANTED, with Experience in Crushing, Screening, Elevating and Conveying Plant. State age, experience, salary required, married or single, and when at liberty.—Address, 8409, The Engineer Office. 8409 A

DRAUGHTSMAN REQUIRED with First-class experience in the design of Material Handling Plants, &c. State age and experience and salary required.—Address, 8406, The Engineer Office. 8406 A

DRAUGHTSMAN REQUIRED, with Knowledge of Commercial Vehicle design.—Address, giving age and particulars of experience, 8335, The Engineer Office. 8335 A

DRAUGHTSMAN WANTED IMMEDIATELY. Experience in design and construction of Steel Work for Factory Building and preferably experience in Building Constructional Work generally. N.W. London suburb. State age, experience, and salary required.—Address, P279, The Engineer Office. P279 A

DRAUGHTSMEN (2) REQUIRED for Estimating Dept., Constructional Works, dealing in all classes of Steel-framed Buildings and Light Bridge Work for home and abroad. Only men of ability need apply. State age, experience, and salary expected.—Address, "STEEL," Wm. Porteous and Co., Advertising Agents, Glasgow. P281 A

DRAUGHTSMAN WANTED; Only Those with large experience in Colliery Winding, Haulage and other Mining Machinery need apply. State age, experience, and wages required.—Address, 8316, The Engineer Office. 8316 A

For continuation of Small Advertisements see page 3.

A Seven-Day Journal

Waterloo Bridge.

ON Tuesday the London County Council had laid before it an important report prepared by its Special Committee on Thames Bridges. The Committee reported that, following the best expert advice, it had come to the conclusion that Waterloo Bridge was worn out and that it must be taken down to prevent it from falling. To rebuild and widen the structure without interfering with Rennie's general design, it was held, would be in the nature of an unfortunate compromise, and accordingly the construction of an entirely new bridge was advised. The new design recommended would have not more than five arches and would be wide enough to carry six lines of vehicular traffic. Its maximum cost was estimated at £1,295,000. On the north bank of the river the traffic to and from the bridge would avoid the already congested area of the Strand by passing through a tunnel which, it was suggested, should start in Aldwych, and diving down below the Strand, emerge in Wellington-street close to the bridge approach. The cost of this subway was estimated at £150,000. The Committee did not approve of a bridge being constructed either at St. Paul's or at the Temple, but urged that inquiry should be made as to the possibility of securing the co-operation of all concerned in a scheme for a new road bridge at Charing Cross. While recognising that this last-named suggestion would provide very great relief, the Committee did not seek to hide the fact that it would be a very costly undertaking—too costly, in fact, for the London ratepayers alone to shoulder. Moreover, it would involve securing the hearty co-operation of the Southern Railway as a necessary preliminary.

Glasgow and the Smoke Evil.

As a centre of smoke Glasgow is surpassed by few cities in the kingdom. No doubt some of those responsible for a portion of the atmospheric pollution may argue, as the Sheffield steel makers have done, that the creation of smoke is a necessary part of their manufacturing processes and could not be intermitted without hurt to those processes. Nevertheless, the Corporation and inhabitants of the northern city are determined to do what they can to suppress the nuisance. A short time ago experiments were begun with the production of smokeless fuel, to which end a plant on the Maclaurin system was installed at the Corporation's Dalmarnock gasworks. That step did not, however, exhaust the energies of the reformers. They have now, we notice, turned their attention to the railway locomotives that ply within their gates. The Corporation's Health Committee has taken the matter up and is urging the Town Council to seek parliamentary powers to prohibit the use of steam locomotives in the city area. The contemplated abolition is to be accomplished within a period of years to be prescribed later. This drastic proposal, we trust, will not be taken too literally. If it were made effective as it stands it would forbid the use of oil-fired locomotives, even though they were completely innocent of the emission of smoke. The ulterior intention, however, would seem to be to force the railway companies serving the city to electrify their lines in its neighbourhood. If that be the real intention the proposal would effectively discourage the development of the internal combustion locomotive. Moreover, the natural and necessary complement to the Corporation's action in this matter would be the prohibition by the Clyde Trustees of coal firing on all the vessels using their romantic river, a step for which, in spite of the progress being made with the motor ship, marine navigation is still far from ready.

St. Paul's Cathedral.

THE final and unanimous report of the Commission of Experts appointed in October, 1921, by the authorities of St. Paul's Cathedral to inquire into the stability and preservation of the fabric was published on Tuesday. The Commission, consisting of two architects, Sir Aston Webb and Mr. M. E. Macartney, and three engineers, Mr. Basil Mott, Mr. E. C. Trench, and Mr. G. W. Humphreys, confirms its belief in the efficacy of the process of consolidating the main piers supporting the dome by grouting through bore-holes, a process which is now being actively carried out. During the grouting operations the piers are strengthened temporarily by means of steel and timber casings. Metal rods are embedded in the bore-holes to reinforce the piers, and any defective ashlar is replaced. The Commission also recommends that two systems of metal hooping should be applied to the inner and outer drums of the dome to check any cumulative, as distinct from seasonal, increase in their circumferences. It is of interest to note that the total weight of the dome and its supports is responsible for a load on the earth of 67,270 tons. The subsoil is not uniform as regards the strata, and there seems little doubt that settlement of the structure during its erection occurred from this cause, and from the fact that the area covered extended beyond the area that had been consolidated by old St. Paul's. The settlement of the foundations would now appear to have ceased. The Commission is opposed to the suggestion that has been made on several occasions that the weight of the dome should be distributed over the masonry composing the bastions—such a suggestion was made by Mr. Harvey in his article in our issue of January 30th. It maintains that such a course involving a considerable change in the disposition of the loading would undoubtedly upset the prevailing balance and would be productive of farther settlement. The Commission also disputes the statement that the inner ends of the pier tops are loaded to as high a figure as 50 tons per square foot, and argue that the stress cannot exceed half that amount. In any event, it is added, tests at the National Physical Laboratory showed that the stone did not crack until a load of 400 tons per square foot was reached.

Rating of Machinery.

IT would appear that the agitation which has been carried on for many years with the purpose of securing a modification in the practice of rating machinery in England and Wales, an agitation which frequently has seemed to come within sight of a successful issue only to be baulked, is once more on the point of achieving its end. An Inter-departmental Committee, presided over by the Right Hon. Edward Shortt, K.C., has been inquiring into the subject and has pronounced favourably in the matter of discriminating for rating purposes between, broadly speaking, plant, machinery or equipment forming part of the hereditament and plant, machinery or equipment which could be removed or installed without altering the hereditament. The Committee proposes to divide all plant, &c., into two classes, the first of which is to be subject to full rating and the second to 25 per cent. of the full rating. In Class I. are included all engines, motors, shafting, cables, pipes, tanks, pumps, economisers, mechanical stokers, chargers and conveyors for generating, storing, controlling or transmitting power—other than portable or travelling power—or for the lighting, heating, cooling, ventilating, draining of or the supplying of water to the hereditament. This class also includes such plant as lifts and elevators, railway or tramway tracks, gasholders, blast-furnaces, coke ovens, tar distilling equipment, cupolas, and water towers. Class II. includes all plant and machinery not in Class I. It is proposed that the present practice of excluding from valuation loose tools, loose plant and machines operated by hand or foot power shall be declared to be the law. The Committee recommends that valuations should be made by professional valuers at intervals of not more than five years and that a panel of referees should be set up for deciding to which class any piece of plant or machinery belongs.

Linking up Electric Generating Stations.

THE special committee appointed by the Government to inquire into the present methods of generating and supplying electricity in this country and the manner in which they can be improved has almost completed its report. Two recommendations which the Committee has apparently decided upon are the standardisation of frequency and the grouping or amalgamation of generating stations. The present varied practice in regard to the frequency of current is stated to be one of the primary difficulties which the Committee found in the course of its investigations to stand in the way of a scheme of amalgamating electric power stations, which are far too numerous for efficient and cheap generation. It is understood that the Committee has come to the conclusion that an expenditure of about ten millions sterling will be needed to replace low-frequency by high-frequency plant, and thus bring the generating stations into line with each other. We must confess that until further information is available, it is a little difficult to see how a change over to a 50-cycle supply is going to be brought about. Mr. Chattock, chief electrical engineer to the Birmingham Corporation, has recently pointed out that the change would cause an enormous dislocation of supply and trade disturbance in Birmingham, and the same state of affairs would no doubt be experienced in certain other areas.

A Suggested Company Reconstruction.

THE well-known, old-established firm of John Spencer and Sons, Limited, Newburn Steel Works, Newcastle-on-Tyne, is in voluntary liquidation, but on Feb. 13th, at a meeting of the creditors, the liquidator, Mr. R. P. Winter, intimated that it was intended to try to reconstruct the company. The record of the undertaking has been a good one. From 1889 to 1920 there was a net profit, after allowing for debenture interest and preference dividends, each year, with the exception of 1893 and 1909, when small losses were incurred. For the five years before the war the average net profits amounted to £42,000, and for the eight years 1915–22 the average was £109,154. It was only in 1923 and 1924 that real losses were shown. The liquidator stated that a sum of about £200,000 would be required to pay off the debentures, interest, receivers' costs, &c., and that the creditors' claims, including those of the Income Tax Commissioners, amounted to £34,000. The assets, consisting of land, buildings, plant, &c., were valued at £523,000, while the loose or liquid assets amounted to £76,000. If the assets were realised, a sum of nearly £400,000 would thus be available for the creditors. Although the book value of the land, buildings, &c., was £523,000, the company, Mr. Winter stated, had from first to last expended over a million pounds on the acquisition of these assets. It was impossible to estimate what they would realise if sold by auction. Application had been made for leave to engage an expert to examine the works and to report as to their value, and the sum required to bring them up to date. When the expert's report was received, steps would be taken to formulate a scheme of reconstruction.

The Manufacture of Steel Houses.

A DEFINITE position has now been reached in the lengthy negotiations between the Glasgow Town Council and G. and J. Weir, Limited, of Cathcart, regarding the supply and erection of twenty steel houses in Glasgow. Messrs. Weir have now informed the Town Clerk of Glasgow that they are unable to accept the contract on the terms stated, which, according to the standing orders of the Corporation, require building trade wages and conditions to be complied with. In expressing regret at the position which has arisen, the firm states that it cannot accept the implication that it should regulate the method and rates of payment and other matters of internal economy in its factory according to the standards which have been set up by an authority whose methods it does not use, and whose members it does not employ. It is pointed out that such a course, if adopted, would detrimentally affect the efficiency of the factory and the rapidity and cost of production, and would not be helpful in attaining the solution of the housing problem which the firm has in view.

Electrical Research.

THE fourth annual meeting of the British Electrical and Allied Industries' Research Association was held a few days ago at the Savoy Hotel, London, when the report recording the activities of the Association during 1924 was adopted. The meeting was followed by a luncheon, over which the new President, Sir Philip Nash, presided. In the absence of the retiring President, Sir Richard Glazebrook, who was unable to attend, on account of illness, Sir Frank Heath, secretary of the Department of Scientific and Industrial Research, proposed the toast of "The Association." There was no industry, he said, in which research was more important than in the electrical industry. The three largest electrical companies in America—namely, the Western Electric Company, the Westinghouse Company, and the General Electric Company—spent more money on research than all the other industries in the United States. During the past four and a half years the Association had done very useful work, but a great deal more remained to be done, and as spokesman of the Government Department, he did not think that the Association would find the Advisory Council of the Department or the Department itself unwilling to consider ambitious proposals. In replying to the toast, the Chairman called attention to the fact that the Association had carried out some valuable investigations in connection with insulating materials. Work of that nature was, he claimed, of value to the electrical industry as a whole, for it benefited the consumer of electricity as well as the manufacturer. In the past, the Association had depended upon the assistance of the Government, but before it could approach the Government and ask for a continuance of that support, he thought it must satisfy the Government that the industry itself was doing all that it should do to support the work of research.

Chamber of Shipping Report.

ACCORDING to the annual report of the Chamber of Shipping for 1924–25, which has just been issued, the depression in the shipping industry continues. During the year under review the running expenses of steamers were slightly less than in the previous year, but although the proportion of charges for coal and insurance decreased, there was an increase in the costs of oil and stores. The cost of handling goods at the ports increased by reason of the extra wages paid to the dockers. A general survey of the whole industry, the report goes on to say, shows that in the balance British cargo-carrying ships made little or no profit during the year. Only by conserving their resources have the shipping companies avoided getting into a serious position. Since June, 1914, the tonnage of the United Kingdom has only increased by 40,000 tons gross, and the effective proportion relative to the world's tonnage may be said to be 35 per cent., making due allowance for obsolete or uneconomical vessels still on the registers. It is considered that the British tonnage is in a satisfactory condition, considering its age and the work it has to do. There is a continual tendency to scrap old ships and motor-propelled vessels are increasing in number. The fact that the motor tonnage laid down during the last quarter of 1924 was only 4½ per cent. of the total, would, however, seem to suggest that the decrease in coal prices and the tendency towards increase in the price of oil fuel have checked for the time being the rise in the tonnage curve of motor ship construction.

The British Steam Railway Locomotive from 1825 to 1924.

By E. L. AHRONS, M.I. Mech. E.

No. VIII.*

PERIOD 1841 TO 1848 (*continued*).

Stockton and Darlington Railway Long Boiler Passenger Engines.—Before leaving long boiler passenger engines, a type with inside cylinders—Fig. 52—built by Alfred Kitching, of Hope Town Foundry, Darlington, in 1848, for the S. and D.R., deserves

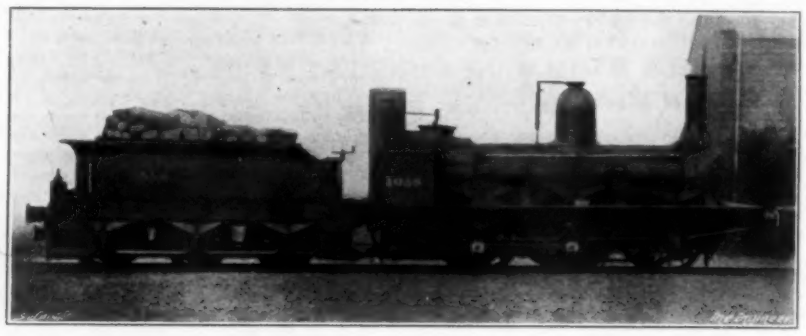


FIG. 53—KITCHING'S STOCKTON AND DARLINGTON ENGINE, 1848

mention. It differed from Stephenson's designs in that both inside and outside frames were used. The cylinders were 14in. by 20in.; coupled wheels, 5ft. 2in.; and leading wheels, 3ft. 8in. diameter; wheel base, 11ft. 2½in., of which only 5ft. 4in. separated the coupled wheel centres; the weight was 24 tons 13 cwt. in working order, and the remarkably high boiler pressure of 120 lb. was carried.

The S. and D.R. passenger engines designed or built at Shildon were not very successful, unless the small 2–2–2 engine "Meteor," No. 50—Fig. 44 *ante*—be excepted, and it was only when Messrs. Kitching came to the rescue, with the "Woodlands" class just mentioned, that a passenger engine suitable for the requirements of the line came into being. Kitching's type, with larger cylinders, 15in. by 20in. and 16in. by 19in., was built until 1860.

Amongst the Shildon-built engines were two curiosities, the "Rokeby" and "Ruby," illustrated in THE ENGINEER of February 6th, 1885, page 95. They came out in 1847, and were of the 2–4–0 type, with 6ft. driving wheels and outside cylinders, 14in. by 24in. The connecting-rods drove the trailing pair of coupled wheels, and the coupling-rod pins in the front pair worked in a slotted "crosshead," to which the connecting-rod was attached. This arrangement was subsequently suggested by Professor Redtenbacher in Germany.

Long Boiler Goods Engines, Six-wheels Coupled.—Whatever the demerits of the passenger engines, the long boiler 0–6–0 goods engines were an undoubted success. The inside cylinder type—Fig. 53—was brought out by Stephenson in 1843, when two engines were built for the York and North Midland Railway, followed by one for the Midland Railway in 1844.

Apart from the long boilers, in these engines we meet for the first time with inside cylinders and six coupled wheels combined with inside plate frames; moreover, the cylinders were inclined downwards to enable the slide bars to be placed above the leading axle, replacing the clumsy method which prevailed up to that time of arranging them beneath this axle.

From 1843 to 1860 a very large number of these engines were built by most British locomotive firms for all railways. Being used for slow-speed traffic, they did not suffer from the swaying defect of the passenger engines, more especially since the cylinders were inside, and they also had the advantage of being able to negotiate sharp curves into yards and sidings. In most of the early engines, the driving wheels were flangeless, though in later engines thinned flanges were added. The early engines, 1843 to 1847, had Gothic type fire-boxes, but subsequent engines were provided with ordinary round-topped fire-boxes. The cylinders were generally 15in. by 24in., the coupled wheels varied from 4ft. 6in. to 4ft. 9in. diameter, and these remained standard dimensions until 1852, when 16in. cylinders and 5ft. wheels came into use. The wheel base was generally about 11ft. in the early engines, and the boiler barrels were about 12ft. 6in. long. The total heating surface varied from 770 to 870 square feet, but the fire-box was necessarily restricted in length, and provided about 60 square feet of the above amount with a grate area of 10½ square feet. The pressure in the first engines was about 80 lb., but had been increased to 100 lb. in some of the 1848 engines.

Some railways, notably the N.E.R., including the S. and D. section, continued to build inside cylinder 0–6–0 engines, with all wheels in front of the fire-box, until 1875, and at a still later date Beyer, Peacock exported them to New South Wales. These later engines were considerably larger, with 17in. and 18in. cylinders, and in addition to the facility with which they traversed sharp curves, W. Bouch considered that the extra area of water surface enabled them to carry the water better without priming. After Messrs. Stephenson had supplied several in 1846–7 to the Paris-Orleans and Marseilles–Avignon railways, they became a standard type in France, where they were known as the "Mammoth" class. Many are still at work in that country.

Two interesting inside cylinder long boiler 0–6–0 engines were built in 1844 by B. Hick and Son. A sectional elevation of these was given in THE ENGINEER of July 30th, 1920, page 103. They had bar frames and Bury type fire-boxes. The cylinders, as was usual in all six-coupled engines, except those by Stephenson mentioned previously, were inclined upwards. The boiler was rigidly fastened to the bar frames by brackets placed immediately above each axle. The design was suggested by Mr. Kearsley, locomotive superintendent of the Midland Counties Railway.

The 0–6–0 Engine with Outside Cylinders.—The 0–6–0 engine with outside cylinders has never been liked in this country. The earliest examples were

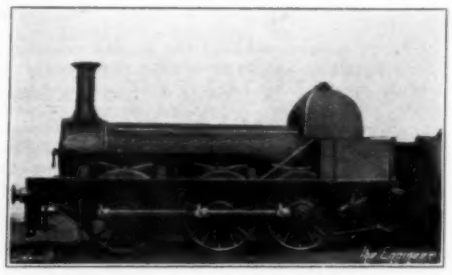


FIG. 53—STEPHENSON'S GOODS ENGINE, 1843

built at the Shildon Works of the S. and D.R. in 1847 by W. Bouch. There were only three of the class—Fig. 54—which, like most S. and D. engines, presented special peculiarities. The cylinders, 16in. by 24in., were horizontal, the coupled wheels, 4ft. diameter, were of cast iron, the centres, unlike Hackworth's plug wheels, being in one piece. The total wheel base was only 8ft. 8in., and there was necessarily a very big overhang at each end, so that the leading wheels carried a weight of 10 tons 5 cwt. and the drivers only 8 tons 11 cwt., of a total of 25 tons 11 cwt. The connecting-rods were placed next to the wheels, with the coupling-rods outside, and to allow them to clear the pins they were made with a large circular eye opposite the leading wheel. To accommodate this eye, the two slide bars were spaced vertically 2ft. 6in. apart. The steam chests were inside, but instead of working the valves in a straight line from the excentrics, horizontal rocking levers were provided with a fulcrum on the centre line of the engine. The excentric rods were coupled to the ends of the levers, and the valve spindle on each side was connected to a point between the fulcrum and the excentric rod connection. A diagram of this gear was given in THE ENGINEER, October, 1875. The boiler was large but badly proportioned. It was 13ft. 10in. long by 4ft. diameter, but contained only 107 tubes, 14ft. 2in. long, and the total heating surface was only 826 square feet. The pressure was 80 lb., and the grate area 10 square feet only. These peculiar engines were fitted with steam brakes.

The only other outside horizontal cylinder six-coupled locomotives of importance consisted of thirty-nine engines built in 1874–7 for the Caledonian Railway and will be mentioned subsequently.

The long boiler engine of this type found a home on the Continent, where it was the standard goods engine in all countries for many years.

Banking Engines.—During this period heavy tank locomotives for assisting trains up inclines made their appearance. For the Lickey incline J. E. McConnell converted some of the Norris American tender engines into saddle tank engines, and in June, 1845, built at Bromsgrove a heavy six-wheels coupled saddle tank engine, the "Great Britain," for this special service. Unfortunately, no illustration of this locomotive, at that time the most powerful in the country, is known to exist, but the following particulars were given in the Gauge report:—Cylinders, outside, 18in. by 26in., placed at 6ft. 2in. centres; six coupled wheels, 3ft. 9in. diameter; wheel base, 6ft. 9½in. + 6ft. 11in.; boiler, 12ft. long, of oval section, 3ft. 10in. vertical, 3ft. 9in. horizontal diameter; 134 2in. tubes, 12ft. 6in long; the weight was 30 tons, of which 12 tons were carried on the middle and 9 tons on each of the other axles. As the height of the lower edge of the cylinders was only 2ft. above rail level, these must have been attached to the frames below the smoke-box without the steep inclination which was the fault of so many engines at that time. As the fire-box casing was 4ft. 4½in. wide, the inside frames cannot have been extended to the back buffer beam, though what arrangement was made for the trailing bearings is not known. The water was carried in a saddle tank, 11ft. 9in. long. It was stated by McConnell that this engine had taken a gross load of 135 tons up the incline of 1 in 37 at 8 to 10 miles per hour.

The other banking tank engines—Fig. 55[1]—were built at the Cowlairs Works of the Edinburgh and Glasgow Railway in 1844 to the designs of Mr. Paton for working the steep incline from Glasgow (Queen-street) to Cowlairs. This incline had been worked by rope haulage with the stationary engine built by Neilson and Co. in 1842, illustrated in THE ENGINEER of December 1st, 1922, page 570. Mr. Paton, the locomotive superintendent, determined to try locomotives, of which two, "Hercules" and "Samson," were constructed. The inclined outside cylinders were 15½in. by 25in., and the wheels 4ft. 3½in. diameter. The steam chests were above the cylinders and the valves were driven from excentrics on the driving axle through the intermediary of rocking shafts. The driving wheels were supplied with brake blocks actuated by levers and screw, but the trailing wheels were provided with a steam brake, the cylinder of which was placed underneath the footplate above the axle. Sand boxes were placed near the front buffer beam, and to clean the rails hot water jets were used, similar in principle to the arrangement previously used by Melling on the Liverpool and Manchester Railway. The well tanks were placed under the smoke-box, and had a capacity of only 200 gallons. The engines weighed 26½ tons. They were used on the Cowlairs incline for only three or four years, and appear to have been discarded on account of the emission of smoke in the tunnel, though it was also stated that they broke a number of rails. Subsequently, a return was made to the rope haulage system.

Balancing and Balanced Locomotives.—The subject of balancing locomotives was frequently mentioned during the Gauge Commission of 1845. At an early date, as speeds increased, it was seen that a balance for the revolving masses was necessary, and in 1837 several engineers, such as Sharp Roberts and Braithwaite and Milner, the latter firm on the Eastern Counties Railway, applied weights in the driving wheels. In 1840 Thomas Hunt, then locomotive superintendent of the North Union Railway, placed weights embracing two spokes in the driving wheels of the four wheeled Bury locomotives on that line.

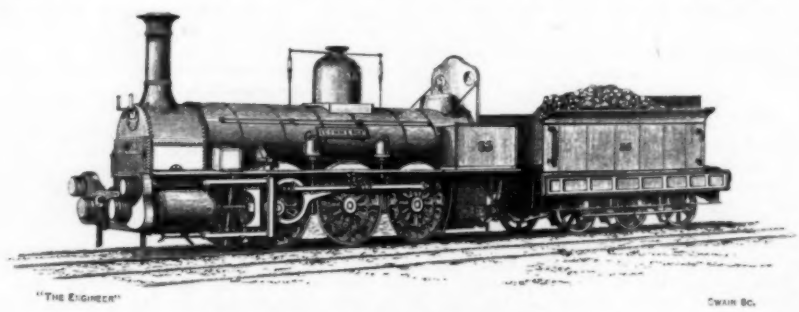


FIG. 54—S. AND D. ENGINE "COMMERCE," 1847

* No. VII. appeared February 13th.

[1] Fig. 55 has been drawn from an illustration supplied to the *Railway Magazine*, April, 1898, by Mr. John Conacher, then general manager of the North British Railway.

These weights were placed opposite each crank and in most cases they were formed by extensions of the wheel bosses. The writer does not know whether any of the above engineers placed the weights in the rims, but the 0–6–0 goods engines by John Gray for the Hull and Selby Railway—Fig. 43 *ante*—certainly had such weights in 1844, if not earlier.

The first engineer who appears to have seen the necessity for balancing the reciprocating masses was John G. Bodmer, a Swiss who settled in Bolton, and afterwards built a few locomotives in Manchester. In 1834 Bodmer took out a patent for two pistons moving in opposite directions in the same cylinder.

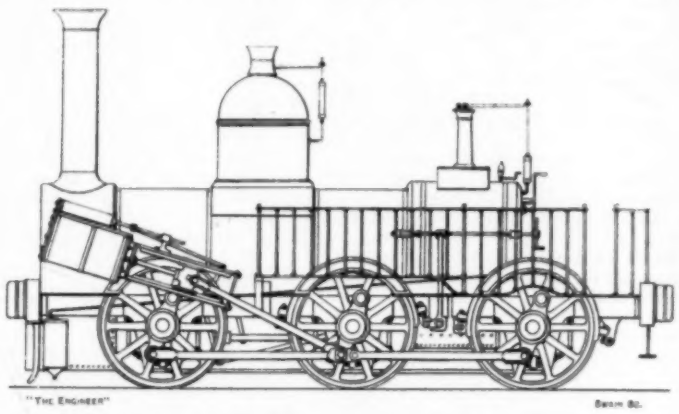


FIG. 55—BANKING ENGINE, EDINBURGH AND GLASGOW RAILWAY, 1844

Two locomotives, which will be mentioned below, were subsequently built in 1845 on this principle.

In 1839 Heaton of Birmingham proposed to balance the reciprocating masses by means of bob weights, which involved a connecting-rod, heavy crosshead and slide bars on the opposite side of the crank—see THE ENGINEER, January 30th, 1880, page 77—and it was stated that an engine was fitted with this arrangement. It was applicable only to outside cylinder engines, and proved too complicated, though the steadiness of the engine was improved.

T. R. Crampton pointed out in the *Railway Times*, 1842, that the cause of oscillation of a locomotive was not the steam pressure, but the unbalanced reciprocating masses. In the first Crampton engines of 1846 these were balanced by weights in the bosses of the driving wheels.

The unsteadiness of some of the long boiler passenger engines, especially those with outside cylinders and middle driving wheels, drew further attention to the subject. R. Stephenson before the Gauge Commissioners stated that some outside cylinder engines had more "yawing"—*i.e.*, swaying—motion than he liked, and he gave the same reason as that previously given by Crampton. But the long boiler 2–2–2 engines of 1845, the "White Horse of Kent" class on the S.E.R.—similar to Fig. 49 *ante*—according to General Pasley's evidence before the Commission, were without balance weights.

W. Fernihough, locomotive superintendent of the Eastern Counties Railway, appears to have been the first to use weights in the rims of the wheels, heavy enough not only to balance the revolving masses, but also the pistons and other reciprocating masses. He informed the Gauge Commission that the engines so fitted were "infinitely more steady afterwards." Perhaps the most interesting portion of his evidence was the prophecy of the multi-cylinder uncoupled engine of the Webb and first de Glehn types of 1882–1886, as follows:—"It is possible to make one pair of cylinders working on one pair of driving wheels, and another pair of cylinders on another pair of driving wheels, because coupled engines have great disadvantages for passengers at high speeds." Subsequently, in 1849, Le Chatelier published the theory of balancing, which laid down the rules practised by D. K. Clark and those who followed him.

Bodmer's Locomotives.—Bodmer's two balanced locomotives of 1845 were built for the South-Eastern and Brighton Railways, and are illustrated in Fig. 56[2]. The driving wheels were 5ft. 6in. diameter and the cylinders 16in. diameter, with an equivalent stroke of 30in., each of the two pistons having an actual stroke of 15in. The arrangement is shown in the plan view. The two pistons moved in opposite directions, the piston-rod of the front one working inside a tubular rod to which the back piston was attached. The two connecting-rods on each side worked on cantilever gudgeon pins fixed on the right and left of their respective crossheads, and the crank axle was a complicated forging with two throws on each side at 180 deg. with each other, but at 90 deg. with the two throws on the opposite side. The axle journals worked in brasses which had spherical bearings in the bodies of the axle-boxes, and the latter had oil instead of grease lubrication. The reversing was effected by a special form of Stephenson link motion, but expansion was produced by a form of Meyer slide valve, the blocks of which were regulated by screw gear.

[2] For full particulars and details of Bodmer's locomotives, with illustrations from original drawings, see THE ENGINEER of March 5th, 1909.

A defect in the design was the unequal length of the two connecting-rods on each side, the one for the front piston being very short. It is stated that Bodmer, to remedy this defect, got out a design in which the rods were of equal length, but no particulars are available. Bodmer used 95 lb. steam pressure. The South-Eastern engine does not appear to have done much work, but the Brighton engine ran until 1859, when it was reconstructed as an ordinary engine with new 15in. by 20in. cylinders.

Constructional Details.—The question of inside *versus* outside cylinders assumed considerable importance during this period. Some locomotive engineers such as B. Cubitt and Fernihough, found that the driving axle-boxes of outside cylinder engines then required more attention than those of inside cylinder engines, and after having been out of the shops a few weeks axle-box wear caused additional oscillation in the former. Gray was also strongly in favour of inside cylinder engines. R. Stephenson, who built many outside cylinder engines at this time, stated in 1849 ("Proc.," Inst. C.E.) that after years of experience he was inclined to regret their use. But Joseph Locke, prompted by experience of broken crank axles on the Earlestown curves of the G.J.R., was a staunch advocate of outside cylinders. In regard to crank axles, difficulties in their manufacture were being overcome in this country and a better axle resulted. R. Stephenson advocated outside cylinders for foreign railways on the grounds that it was then difficult on the Continent to make a good crank axle.

Bogies were considered unsafe at high speeds, and, except upon the American type engines of the Birmingham and Gloucester Railway, were not used on any main line. The objection of British engineers was due to the short bogie wheel base, then only about 3ft., as a result of which and the absence of a suitable centre plate, it was feared that they would tend to set themselves across the track. Fernihough, indeed, in 1845, proposed a large bogie plate or ring to oppose frictional resistance to this action, but it was about fifteen years later before this idea was adopted.

Wheels were generally made with cast iron bosses, but solid round spokes had displaced the old tubular form, which, when cast in, subsequently worked loose in the boss. By splitting and opening the ends of the solid spokes before casting the boss round them, a firmer job resulted. The outer end of each spoke was welded to a piece of flat iron bent into a segment of proper length, and after the boss had been cast on the segments were welded together to form the rim. Occasionally wrought iron rings were shrunk on the bosses.

Bury's wheels had solid wrought iron spokes with conical ends which were keyed into holes bored in the cast iron naves. The outer ends had forged T heads riveted to a wrought iron rim about 1in. thick.

Many of Stephenson's wheels of the 1843 to 1848 period were made as in Fig. 49 *ante*, with cast iron bosses, the spokes and rim being formed of T irons placed back to back and bent round. The triangular spaces between each spoke and the tire were tightly wedged with oak pieces. This form of wheel was also used by Tayleur and by Jones and Potts in the "long boiler" engines built by them.

Solid wrought iron wheels do not appear to have been much used until a few years later. Colburn illustrates on page 47 of "Locomotive Engineering" a wheel of this type invented by John Day in 1835, which, after the patent had expired, became the standard wheel almost universally used from about 1847 onwards. Day's type of wheel was regularly made by John Dewrance from 1840 to 1845 at the Edge Hill shops of the Liverpool and Manchester Railway. When these wheels were first made it is very doubtful whether a Nasmyth steam hammer was available. The cast iron wheels designed by Sharp Bros. in 1846 for heavy goods engines may be mentioned here. These were of channel section with a T-shaped circular rib round the wheel at about 13in. from its centre. The spokes between this rib and the rim were of T section. The engines will be mentioned subsequently; the wheel is illustrated in D. K. Clark's "Railway Machinery," page 214. Still earlier cast iron wheels with spokes of H section, similar to Webb's design, was made in 1840 in the shops of the Dublin and Kingstown Railway—see THE ENGINEER, June 24th, 1898.

Tires were of wrought iron welded at the joint, and before 1838–1840 were shrunk on without other fastening. About this time it was found necessary to use additional means for securing them and rivets through the wheel rims were introduced.

According to the late W. P. Marshall, D. Gooch in 1840 on the G.W.R. added a steel bar to the pile from which the tire was rolled. This was worked in to form the tread of the tire, which had to be faced by grinding, since it was too hard to be turned after having been chilled by shrinking on the wheel centre. W. P. Marshall was one of R. Stephenson's assistants, for two years, 1840–1842, locomotive superintendent of the North Midland Railway, and afterwards the first secretary of the Institution of Mechanical Engineers. He had first-hand knowledge of early locomotive developments. In "A Story of Railway Pioneers," by Major Snell, M.C., the credit for steeled faces on locomotive tires is given to Isaac Dodds, who with Jessop, of Sheffield, worked out a process for a rim of steel on an iron tire by continuous welding during the passage of the bar through the rolling mill. The date given for this process is about 1850, so that Gooch must have anticipated it by several years.

On the Liverpool and Manchester Railway John Dewrance is stated to have forged the excentric sheaves solid with the crank axle.

The most important improvement during this period was the Williams-Howe link motion brought out by R. Stephenson and Co. in 1842. The first locomotive fitted with it was North Midland No. 71, a 2–4–0 long boiler goods engine which came out on October 15th, 1842.

The wedge motion by Isaac Dodds was patented in 1839 and tried on an engine of the Sheffield and Rotherham Railway, and subsequently applied in 1842 to three engines on the North Midland Railway. In the earliest engine Dodds used the wedge excentric for reversing only, a second excentric with expansion valve being added. Subsequent modifications enabled the wedge motion to be used also as an expansion gear, and a single excentric was employed provided with a double wedge. When the wedge was moved by levers along a square section of the axle it acted upon corresponding inclines inside the sheave, so that the latter was moved transversely across the axle. The gear as improved by Henry Dubs was fitted to a number of engines built by the Vulcan Foundry, 1852–5, for South Wales, Ireland and India. Its last application was to passenger and goods engines for the North Staffordshire Railway in 1871–2 under the superintendency of the inventor's son, T. W. Dodds. The gear was simple, but had the defect that the wedges sometimes seized and rendered the gear immovable.

The Gooch stationary link motion appeared in 1843, and must have been first applied to one or more of the Great Western 7ft. singles, "Ixion" class, in

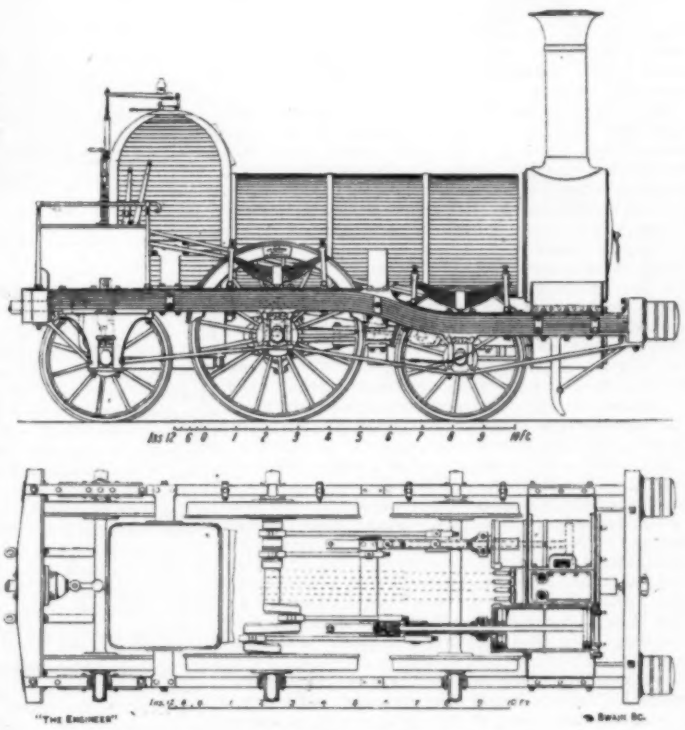


FIG. 56—BODMER'S BALANCED ENGINE

replacement of the previous gab motion, since no new engines for this line were built between October, 1842, and February, 1846. The first new engine fitted with the new gear was John V. Gooch's L. and S.W.R. 6ft. 6in. express engine Snake, turned out from Nine Elms Works, November, 1843. Almost all the G.W.R. broad-gauge engines, including the last three 8ft. singles built in 1888, had it, but on the standard gauge its use ceased with R. Sinclair's engines of 1866 for the G.E.R. and a few Caledonian engines of 1875. It had the defect of an angular drive between the excentric and valve rods; nevertheless it was employed on the Continent to a much greater extent and to a considerably later date than in this country.

J. V. Gooch from 1843 used double ported slide valves on all his L. and S.W.R. engines. The second steam inlets were channels through the body of the valve, on the back of which was a cast iron plate fitted into the steam chest in such a way that it could be adjusted by screws as the valve wore down. There were ports through this plate which coincided with the channels through the valve during admission, but the plate closed the channels during exhaust. But the travel of the valve, which was 4¼in., was, in spite of the double admission, only slightly less than the usual 4¼in. to 4¼in. Joseph Tomlinson, who was at one time under Gooch, stated that these valves gave much trouble, but the latter apparently thought them successful, for he took the design with him to the Eastern Counties Railway. These valves are illustrated in D. K. Clark's "Railway Machinery," plates 11, 12, and 27.

With the long boiler engine Messrs. Stephenson at the same time introduced the driving of short-stroke feed pumps from the back gear excentrics, to which special lugs for the pump rods were attached. Stephenson's pumps and drive were afterwards used by D. Gooch, but John V. Gooch, who also adopted short-stroke pumps, drove them from additional excentrics. The short-stroke pump itself was due to T. Hackworth.

Boilers still suffered from the effects of the low centre of gravity theory, and most engineers seemed willing to do anything rather than raise them. J. V. Gooch bulged in the plates to clear parts of the motion. In the same engineer's goods engines and in McConnell's Lickey banking engines the boilers were elliptical as in some of the earlier Liverpool and Manchester engines. It is a curious commentary on this latter practice that Major-General Pasley, then Chief Inspecting Officer of the Board of Trade, objected to oval boilers, not on account of their deviation from the circular section, but because he considered that the oval form necessitated a slight raising of the centre of gravity. It was not then appreciated that if the boiler were raised 2in. the centre of gravity of the whole engine would be raised approximately one-quarter to one-third of this amount.

Much improvement had been made in boiler construction. The number of longitudinal seams had in general been reduced to two, but these were, with few exceptions, lap jointed. The barrels, having greatly increased in length, were usually in three rings, the middle ring being the largest. In J. V. Gooch's L. and S.W.R. engines butt joints were used for the transverse seams with outer butt strips. Sharp's boilers of 1845 were probably the best of the period. The rings were made of single plates with only one longitudinal seam, and the barrel was, like that of J. V. Gooch, parallel throughout, with planed transverse butt joints and outer butt strips. Some of these boilers after eighteen years' service on the Midland Railway showed none of the grooving in the barrel, so common at one time with transverse lap joints. The construction is shown in plates 19 and 20 of Clark's "Railway Machinery."

D. Gooch in 1845 tried corrugated copper plates to strengthen the flat sides of the fire-box, and J. V. Gooch used them in 1843 for the walls of fire-box midfeather partitions. Both brothers employed Venetian dampers in the smoke-box immediately in front of the tube plate to replace the chimney dampers previously used. Ashpan dampers appear to have been rarely used, ashpans open at the front being usual. John Gray employed iron in preference to brass tubes, being of opinion that they were better in chalky water districts.

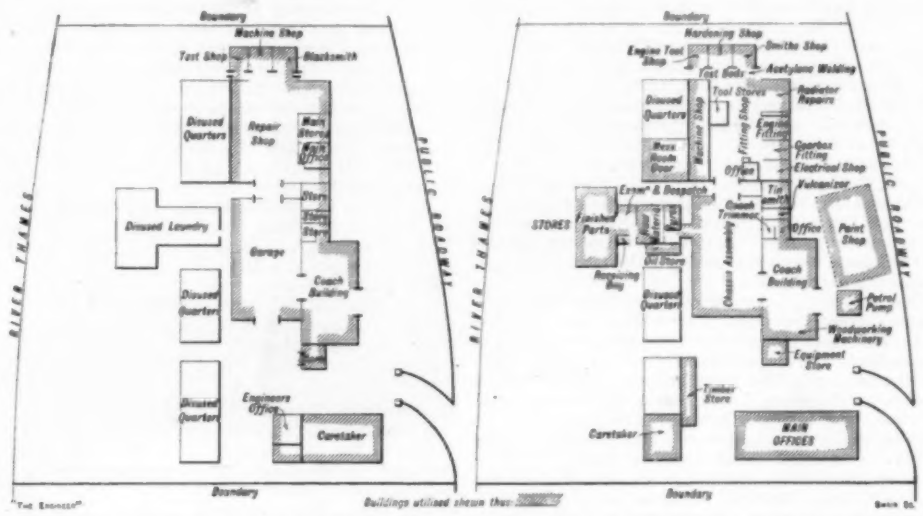
Coal was burnt on the S. and D.R. in Hackworth's return flue boilers, but the few attempts to burn coal in ordinary fire-boxes at this time ended in failure owing to the emission of smoke and the complications which were thought essential. The subject of coal burning will be mentioned subsequently, but for nearly thirty years subsequent to the opening of the Liverpool and Manchester Railway coke was almost the sole fuel.

Motor Transport in a Public Medical Service.

THE rapid development of mechanical transport on the roads in this country during the last twelve years or more, and the large influence it now exerts upon the necessities of the community as a whole, will doubtless prove a prominent feature of the progress made by this generation. Unlike the inception of railways a century ago, which, being slower in development, permitted the rearing of a particular type of skilled servant suited to the requirements, and in synchronism with the material construction, the rapid growth of mechanical road transport has tended to produce a lack of balance between the manufacturing and the maintenance branches, so that the leaning is towards the scrapping or irregular repair of vehicles, rather than to a policy of steady overhaul and maintenance of such rolling stock.

The many departments of public service in which motor vehicles are now employed are obvious to all road users and need not be enumerated, but there exists one section which rarely becomes noticeable, except to the unfortunate—namely, the ambulance service. The actual number of ambulance vehicles now in use in this country is difficult to estimate with accuracy, but that a very large quantity must exist will readily be realised when it is stated that the majority of borough councils, police forces and municipalities each operate one or more motor ambulances, and that the British Red Cross and St. John Ambulance societies are giving an excellent service in many rural districts. Generally speaking, the design of the coachwork of these vehicles follows closely one pattern, which can be traced distinctly to the old Army horse-drawn vehicle evolved about the time of the Crimean War, which lacks little in simplicity of construction, but much in comfort.

In the metropolitan area of London there exists a body under Poor Law administration, comprised of representatives of all the Guardians of the Poor, and known as the Metropolitan Asylums Board, whose primary duty is the segregation of disease under the Notification of Infectious Diseases Act, as administered by the Ministry of Health. For this purpose the Board maintains a large number of fever hospitals and convalescent homes, in addition to asylums for the mentally defective and casual wards for the destitute. In the aggregate there are some sixty such institutions, with 20,000 beds, several being



FIGS. 1 AND 2—ARRANGEMENT OF AMBULANCE REPAIR SHOP BEFORE AND AFTER RE-ORGANISATION

situated as far from London as Lowestoft, Margate, Godalming, Dartford and Watford. To deal with the rapid conveyance of patients from the Metropolis to these institutions a motor ambulance and omnibus service developed out of the original horse-drawn ambulance service, until ninety-two ambulances, twelve omnibuses and char-a-bancs, seventeen lorries and vans, eight motor cars and four trailers are employed to-day in the conveyance of sick or convalescent patients, staff and goods.

At the beginning of 1922, under the chairmanship of the Viscount Doneraile, the writer undertook the organisation of this fleet of vehicles, the circumstances then being that six ambulance stations existed in London, amongst which were nominally distributed some eighty-five ambulances, eight omnibuses and six lorries, where drivers were employed on the relay system. A further group of fifteen vehicles was stationed at Dartford, Kent, whilst nineteen vehicles were scattered by attachment to the larger institutions in rural areas.

For the maintenance of this fleet, an old ambulance station and small-pox receiving depôt at Fulham had been partly adapted to form a small repair shop—see Fig. 1—and at each of the ambulance stations a few small machine tools and bench appliances were installed for running repairs. But the growth of the fleet of vehicles had out-distanced to a dangerous extent the capacity of this plant, so that at that date the works were congested with some thirty vehlices in need of overhaul and unable to run, six new chassis requiring the fitting of omnibus bodies and a construction programme for eighteen new chassis to a special design previously ordered by the Board, the apparent intention being to purchase unfinished parts and material, and to execute the machining and assembly at these repair works. The capacity of these works at this time did not permit the overhaul of a chassis to be executed in less than two months, and actually such work had not been seriously attempted, in spite of the fact that vehicles had been in service for periods of from two to ten years. During the year 1921 and to some extent during that preceding, the demands upon the service had been particularly heavy, so that the annual mileage approximated 1,000,000, or an average per chassis in service of 10,000 miles per annum; but since a number of vehicles had been purchased from War Department disposals, it was not possible to ascertain the actual mileage of each vehicle since manufacture.

The fleet consisted of the following fifteen different makes of vehicles:—Clement-Talbot (in the majority of 2:1), Crossley, Ford, Armstrong-Whitworth, Daimler, Lancia, Napier, Mors, Siddeley-Deasy, Dennis, Berna, A.E.C., Leyland, Straker-Squire, and Vulcan—a condition which rendered store control difficult, and which had been accepted by omission to carry adequate stocks of the various parts to ensure rapid repair or replacement in the instance of breakdowns. These conditions in general rendered it impossible to retain a state of mechanical efficiency, with the result that, apart from inconvenience and expense, caused by breakdowns on the road and the inability of a number of vehicles to run at all, the running costs had reached a high figure, through such factors as oil and petrol consumption. This neglect was reflected in the lowered efficiency of the service staff.

In consequence, a careful inspection of all vehicles was made, and log sheets were prepared, which showed that 80 per cent. of the vehicles needed overhaul or scrapping, and that the remainder would be in a similar state within twelve months. This was a position requiring prompt attention and a comprehensive organisation, the points for consideration being whether the renovation should be undertaken by contractors or direct labour at the repair works, or, as a final alternative, whether each vehicle should be run as long as possible and be then replaced by a new. The first plan did not conform with the policy of the Board, and, moreover, would have required skilled inspectors who were not available, and the last plan was estimated to be unduly expensive from capital and maintenance standpoints. Hence, it was decided to undertake the overhaul at the repair works, and proceed with the reorganisation immediately. To this end it was obvious that the works needed rearrangement, additional tools and plant, a fully equipped store, and additional body-building accommodation, since the condition of bodies genefally was such that deterioration had been accelerated through lack of re-painting.

Sanction was given for the reorganisation of the works with lay-out, as shown in Fig. 2, together with the installation of new plant comprising:—Four American tool-room lathes, one Parkinson gear tooth planer; one cylinder grinder, by A. Herbert, Limited; two tool-room grinders; one 6ft. gas furnace, with pyrometers; one forge and smiths' equipment; one portable shop crane; one universal wood-working machine, by Robinson; one band saw, by Robinson; steel store bins; small tools and bench equipment; works telephones; two engine test benches. A series of views of the rearranged shops is given on page 216.

The period March to August, 1922, was occupied in installing this plant and in re-arranging the works and stores, although at the same time the overhauling of vehicles was proceeded with on a systematic plan. The preparation of six sixteen-passenger omnibuses and the building of six new chassis was also taken in hand. Disused buildings were brought into commission and the boundary walls of the site were put into a serviceable state.

At the end of this period the number of hands employed slightly exceeded one hundred, and the number of vehicles overhauled under the conditions stated in the foregoing paragraph was increased from less than one per month to one per week. It was

possible further to concentrate the works upon a definite overhaul programme, since the works administration system, introduced within the limits of Poor Law methods, allowed for the withdrawal of vehicles from service by turn according to the degree of disrepair—shown by the detail inspection reports made by a competent officer—to be prepared for re-commission. This course resulted in a steady increase in output, so that twelve vehicles per month were being overhauled during the early months of 1923, and by August of that year the whole fleet of ambulances, omnibuses and cars had been restored to an efficient condition.

It was found that some fifteen ambulance chassis which had been in service for seven years or more could not be economically re-conditioned, and that six small omnibus chassis on solid tires were of an obsolete pattern and in a similar state, hence it was decided to dispose of these vehicles and replace them by Clement-Talbot chassis of the slightly modified 25 horse-power type. This step resulted in a reduction of the number of different makes of vehicles, so that four only remained for ambulance and omnibus service, of which the Clement-Talbot type accounted for over 70 per cent., the next largest quantity being Crossley cars, with approximately 12 per cent.

The advisability of constructing a new type of body for these vehicles was then considered, since the then existing pattern did not lend itself to rapid cleansing, disinfecting, efficient ventilation, or general comfort of the patient. Thus a new type of body was designed and a sample manufactured at the works in September, 1923. It met with approval, as an advance towards medical and public requirements, and it was decided to construct bodies of this design, with the special labour-saving fittings, at the Fulham works for twenty-one new Clement-Talbot chassis. Work was begun in September, 1922, and by July, 1923, all were ready for, or in, service. One of these vehicles is illustrated by Fig. 3.

During the period of equipment of the repair works the question of running repairs at the ambulance stations was not neglected, and two mechanics and one vulcaniser, after suitable training, were selected and installed at each ambulance station with sufficient tool equipment, definite limits to the work executed by them being laid down for running repairs. Two mechanics in each instance were necessary, because a twenty-four hour service is maintained. The senior mechanic at each station reports to the works full technical particulars of any road accident or breakdown, makes a weekly return of the adjustments or repairs made on each vehicle in his charge and returns monthly a statement of the condition of each vehicle. With the appointment of a travelling inspector this method proved efficient in considerably raising the standard of mechanical efficiency and reducing running costs, since material defects were detected and remedied at an early stage. Further economy in petrol consumption was obtained by the replacement of two-gallon tins by petrol pumps with underground storage tanks, a complete equipment being installed at each ambulance station and one at Dartford. The economy resulting from this step was calculated to offset the capital charge involved in from eighteen months to two years.

In the Dartford area a supply and repair station for vehicles was installed, with two mechanics, and operated in the same manner as the six ambulance stations, fifteen vehicles being thus controlled, which were in the service of three large medical institutions.

The reorganisation set out above resulted in the fleet of some 140 vehicles—excepting a few old lorries—being brought into a state of mechanical efficiency within eighteen months, and thereby obtaining a 7½ per cent. surplus of vehicles for reserve under emergency conditions, and although re-painting of the coachwork had not been effected throughout owing to delays in the provision of a paint shop, yet suitable accommodation was provided for that purpose after May, 1923, *i.e.*, for the annual overhaul programme adopted.

The total expenditure at the repair works, which included the cost of new plant, additional chassis, bodies and all wages, was for the year March, 1921–1922, only 10 per cent. lower than the equivalent succeeding period, although more than 2 per cent. of this excess was represented by capital charge on new plant and 5 per cent. on stock in hand in stores, whilst the re-equipment of the fleet of vehicles as a whole was obtained with the consequent reduction in annual running costs. Review at the end of this period showed that the mechanics could be reduced in quantity by some 40 per cent. and that future overhauls on an annual or equivalent mileage basis could be carried out at an average cost of £120 per vehicle, which, when dealing with one hundred vehicles per annum, represents a saving in works costs of some £40,000 per annum over that of the period 1921–1922. That sum is available to the reduction of Poor Law rates for the area.

The writer is of the opinion that Poor Law as administered to such works outlined above does not afford the necessary elasticity in costing or labour employment to permit an engineering undertaking to be economically administered, since the inefficient system of bulk accounting, which is not only unwieldy, but also causes a preponderance of clerical staff, prevents a clear statement of individual costs unless high on-costs are consequent, a condition which, unfortunately, remains existent. Such a state of affairs has been appreciated in several of the Colonies in connection with municipal work, where financially successful results are being obtained by the appointment of officers skilled in technical knowledge as well as in book-keeping.

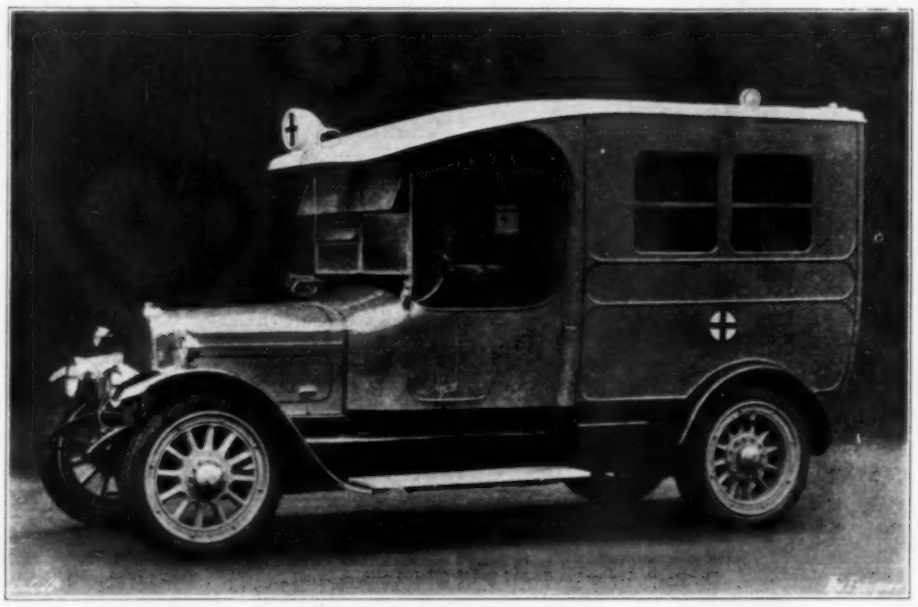


FIG. 3—MOTOR AMBULANCE OF THE METROPOLITAN ASYLUMS BOARD

The Stroboscopic Determination of Speeds and Frequencies.

By G. E. MOORE, A.M.I.E.E.

Introduction: Speed Measurements in General.

There is a host of methods whereby the speed of rotating machinery and the like can be determined. The methods comprise systems and apparatus which are direct reading or otherwise, and which, in regard to accuracy of result, are rough, within "commercial limits," or of precision value. Foremost and oldest is the method involving the use of a revolution counter and a watch. This simple procedure can be resorted to when more elaborate methods are doubted or fail entirely; there seems to be no other method so genuinely satisfactory—one must exclude even instruments combining both counter and watch—and it is a method which is capable of quite a high degree of accuracy. With this counter-and-watch method can be bracketed the graphic apparatus by which electrical contacts on the rotatory machine mark a chart travelling at known rate.

Of the purely mechanical indicators of speed there is that rival to the counter and watch, the centrifugal governor, which unfortunately can be guilty of comparatively large errors. There is also the apparatus in which mechanical resonance is utilised, an indicating instrument containing a set of tuned reeds with speed calibration being attached direct to the plant under test, if high speed, or conveniently actuated by a vibrator on the machinery. In addition, there are several electrical methods—apart from those limited to laboratory environment—all of general utility, offering those qualities of flexibility and remote indication peculiar to electricity. With care they give fair routine accuracy. Then there is the tuned reed indicator worked by an electric make-and-break; there are similar or pointer-type frequency indicators which respond to the alternations in an alternating-current supply system or to tiny auxiliary alternators; and there are voltmeter indicators actuated by the pressure of a subsidiary magneto generator.

In addition to all these more or less well-known methods there is that whereby the speed can be determined stroboscopically. This, in general, is a test method, and it has advantages of a marked character.

The Principle of the Stroboscopic Effect.

"Stroboscope" is derived from Greek words meaning *a twisting or whirling round* and *sight*. It appeared seventy or eighty years ago, at a time when scientific toys of a type which ultimately led to the invention of the kinematograph were presented to the world. The thaumatrope was such a device, and it was succeeded by the phenakistoscope, stroboscope, or magic disc. In 1846 there was mention of stroboscopic plates—an invention by Stampfer, of Vienna, especially interesting and apposite because of the reference to "an impression of an uninterrupted line of light from the rapid motion of a luminous object." Diverse uses for the stroboscopic effect have occasionally appeared in scientific journals. Speed determination stroboscopically seems to be a comparatively recent development.

The stroboscopic effect is visional and is aided by the fact that an image impressed upon the retina of

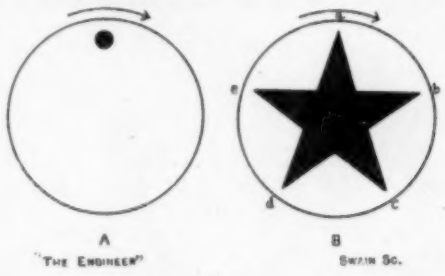


FIG. 1

the human eye tends to persist. A diagrammatic description of the effect affords a straightforward explanation. First of all imagine a white disc, such as Fig. 1A, having a spot painted upon it and rotating as shown, and suppose, too, that your vision can be periodically intercepted. If for an instant you are allowed to see the disc once during each of its revolutions the spot will appear in the same place; if vision is permitted once per two or three revolutions the same holds good. On the other hand, if the eye is allowed more glimpses than one per revolution more than one spot will be seen.

Now let us carry the explanation a step forward with another disc having a five-pointed star painted upon it and also rotating in clockwise direction—Fig. 1B; such a star affords a more practicable and spectacular demonstration. Vision is permitted once per one-fifth revolution. Although the figure is moving it will appear stationary, because after point *a*, say, is seen momentarily, vision is intercepted during one-fifth revolution, and when the next glimpse comes point *a* is in the position left by point *b*, point *b* has taken the place vacated by point *c*, and so on. To the eye, then, the five-pointed figure is standing still. The same illusion is produced if vision is permitted every two-fifths or three-fifths, &c., revolution. On the other hand, if vision is more frequent and the star points are viewed before each reaches the point position ahead more points will be visible; for instance, with glimpse vision per one-tenth revolution the five-pointed star will become a ten-pointed one.

There remains a fascinating and useful effect when the glimpse vision is not of certain values with regard to the rate at which the disc is travelling, *i.e.*, not a multiple or sub-multiple of what may be termed the star-point frequency. If the glimpse vision is such that point *a*, say, is seen before it has reached a "point position" ahead, and similarly with all the other star points, what the eye sees is not a figure with extra points, but a five-pointed star rotating counter-clockwise; if, however, each point during the interception of vision moves more than the point-to-point distance, the five-pointed star moves in the direction in which it actually is travelling. The rate of backward or forward "slip" is proportional to the disparity of glimpse vision compared to the real figure speed. This slip effect can appear near each critical speed at which glimpse frequency permits the stationary effect.

It will be seen that the stroboscopic effect involves

a number of detail results. The effect may be witnessed elsewhere occasionally; for instance, kinematographic pictures of moving vehicles sometimes show the wheels either standing still or moving forwards or backwards at a ridiculously slow rate; the illusion here is due to the number of spokes in the said wheels and the speed of the latter bearing a certain relation to the rate of the kinephotography. But besides spectacular interest, the stroboscopic effect is utilised in such practical instruments as the "Rotascope"—which conveniently make rotary objects appear stationary or almost stationary—one example, due to Ashdown, is unique inasmuch as a special view interrupter, consisting of a rotatable cylinder containing a number of parallel plates, affords binocular

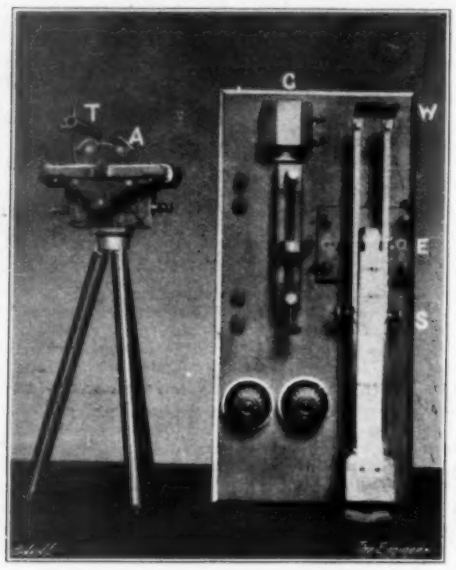


FIG. 2

vision with an unusual degree of illumination and "snap" effect. The "Oscilloscope," by means of "creeper gear" attached to the observed machinery, makes the latter appear to operate at a definite fraction of its actual speed. There is also the application of the stroboscopic effect to speed measurement—the subject for present treatment.

Stroboscopic Apparatus and Methods.

In speed measurement both the stationary and the slip illusions are utilised; the former is preferable, especially because it gives instant indication. The actual stroboscopic effect can be obtained in a variety of ways, of which perhaps the most fitting description may be given by a cursory account of developments in stroboscopic speed measurement. It will be noted that a marked disc or the like is not necessarily employed.

Benischke long ago described speed tests upon electric fans in which, by means of a radially slotted disc rotated by an auxiliary motor fitted with a counter, the fan's vanes were observed; adjustment of the auxiliary motor speed gave the stationary effect, the fan speed being derived from number of observation slots ÷ number of vanes × auxiliary motor speed. A general formula for such apparatus is given by

$$S\,N = s\,n,$$

where S = speed of observed shaft,
s = speed of a slotted "observation" disc,
N = number of indicator marks on shaft's disc,
n = number of slots in observation disc.

There is a practical limit to s of about 2000 revolutions per minute maximum, while N, on the other hand, cannot be less than 1. Hence for such a high speed as 40,000 revolutions per minute n must be 20. Expressed otherwise, one may define the condition as being a balance of mark frequency and glimpse frequency.

If it be desired to consider the matter more closely, account must be taken of the number of stationary images and the relative speed and direction of the two discs. For instance, given a one-slot, one-mark arrangement with equal speeds but opposite rotations, the observer will see a stationary image at 180 deg. at 120 deg. if $S = 2\,s$; at 90 deg. if $S = 3\,s$, and so on. It can be stated that a stationary stroboscopic effect is seen whenever S/s is an integer (1, 2, 3, &c.). The number of coincidences C =

$(S/s + 1)$ with directions of rotation opposite,
or $(S/s - 1)$ with directions of rotation similar.

And if, instead of the one-slot, one-mark arrangement x slots and x marks are used,

$$C = x\,(S/s \pm 1).$$

It is advantageous to reduce the value of x as far as possible, adopting an equal number of slots and marks. Failing this procedure, the expression becomes complicated. The above development has been found useful in tests with high speeds of rotation, such as turbo speeds of 30,000–40,000 revolutions per minute, values much above tachometer limits.

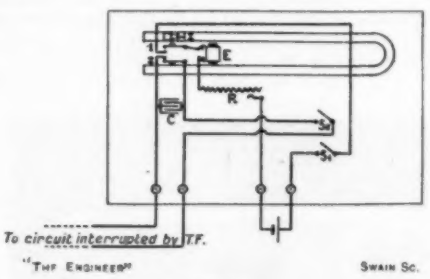


FIG. 3

In the preceding methods the use of a so-called "counting motor" to produce the glimpse effect is required; the speed of this motor must be known, so that the chief advantage of the method is the range afforded and a certain selectivity. There comes the introduction of a further refinement, which takes the form of a tuning fork—generally maintained in oscillation by electrical means—whereby a handy, consistent and precise standard is introduced, the tuning fork being, in a sense, a rapidly operating pendulum, and therefore forming a known time basis. The tuning fork can be used directly and indirectly to provide the requisite standard "glimpse frequency":—

(*a*) Directly by the use of wings or the like fitted to its limbs and so placed as to intercept the observer's line of sight. Light wings, one per prong tip, can be so disposed as to interact. "Edge" vision is given when, with fork at rest, the wings slightly overlap; glimpse frequency = fork frequency. "Slit" vision is given by a slit being uncovered once per prong movement; glimpse frequency here = 2 × fork frequency. (Tuning fork frequency in "double vibrations.")

(*b*) Indirectly by providing a blink illumination from a neon tube actuated by the fork (as arranged by Dr. C. V. Drysdale) or through the medium of a "phonic motor" controlled by the tuning fork and carrying a slotted disc.

Direct use of the tuning fork has the merits of simplicity and the use of existing illumination; the indirect alternatives, however, have special advantages. The "counting motor" arrangement previously referred to can be calibrated at definite points if its speed variation characteristic is to be utilised; preferably it can be displaced altogether in favour of the tuning fork modification.

Improvements in various ways have been introduced. Dr. C. V. Drysdale introduced the special disc—shown in Fig. 4E—for use with his neon tube; by means of a special table supplied by the makers and setting forth speeds and figure combinations an imposing range can be covered. Professor D. Robertson has favoured the use of a multi-frequency tuning fork device with adaptable bars, which has special qualities. Seashore was responsible for a card on which were marked several series of dots, each of a certain number, so that when viewed one particular series stood forth and gave a "main speed" indication. Of stroboscopic modifications these are the outstanding.

So far it has been supposed that stationary stroboscopic images are seen. It will be remembered, however, that such an illusion need not necessarily be obtained; a forward or backward "slip" effect may appear. Therefore the fixed or main speed points need not necessarily be given, for the actual speed of the rotating part under test can be determined from the apparent revolutions, if the value of the latter be expressed as a percentage of the nearest main speed.

This fact is well exemplified by the case of an electrical induction motor. Such a machine runs at a speed somewhat less than the "synchronous speed" of the alternating supply; an observation disc placed upon its shaft and viewed by a suitable lamp connected to the same source (giving a glimpse frequency = 2 × supply ~) or a slotted disc on a synchronous motor run from the same source, will appear to rotate backwards at a speed proportional to the slip. Here

$$\text{Slip per cent.} = (S - s)/S \times 100,$$

where S = synchronous speed and s = actual speed.

Dr. Drysdale introduced a special device for the measurement of such slip. It comprised a subsidiary glimpse arrangement of slotted disc rotated by contact with a conical roller or drum, the latter being driven by a small synchronous motor. The glimpse frequency could therefore be varied slightly and a stationary stroboscopic image be obtained, the "slip" being read off on a percentage scale. A stationary image is so satisfactory that, whenever possible, the writer endeavours to obtain it; he often varies his tuning fork frequency, and on occasion has used an arrangement similar to Dr. Drysdale's conical roller, but tuning fork controlled and affording a blink illumination.

The Author's Stroboscopic Testing Set.

A stroboscopic testing set arranged by the author is illustrated photographically in Fig. 2, the main wiring being shown in Fig. 3. The chief component is the tuning fork board, which comprises a 50 d.v. fork mounted parallel to the wood base. Make-and-break No. 1, actuated by a limb and connected in series with an electro-magnet E, switch S_1, regulating rheostat R, and 2-volt cell, maintains the fork in oscillation; make-and-break No. 2, which is merely in series with switch S_2 and two terminals for connection to circuit to be interrupted, a condenser C across the make-and-break nullifying contact flashing. There are two aluminium wings for attachment to the tips of the tuning fork limbs—Fig. 2w—two sliding weights on the limbs—Fig. 2s—used in conjunction with a scale of fork frequency ranging from 49.5 to 50.5; and an amplitude indicator consisting of a V-shaped figure drawn on cardboard and mounted on a limb—see Fig. 3 I.

Then there is a phonic motor—Fig. 2, left—which is a simple construction of five-toothed iron armature A revolving in a field system. The field system can

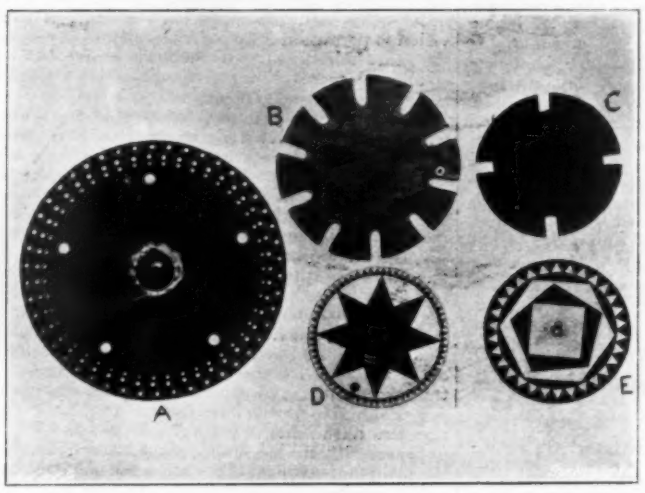


FIG. 4

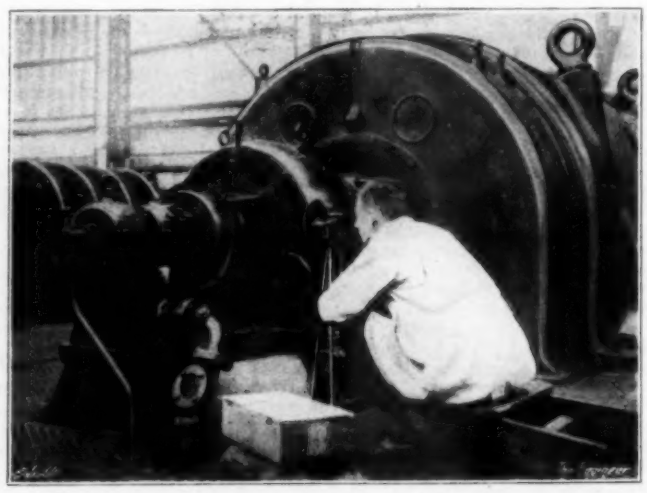


FIG. 5

be excited from either of two sources: (*a*) a 4–6-volt battery in series with make-and-break No. 2 of the tuning fork, the fifty pulsations per second produced by the latter, making it possible for the armature to revolve at a standard speed of 10 revolutions per second; (*b*) alternating-current supply, when any ampérage of 2–6 will drive the rotor—a 40 ~ current giving a convenient synchronous speed of 8 revolutions per second. The phonic motor can readily be started by hand and phased-in from audible or stroboscopic indication. On its projecting spindle discs can be mounted, and when a known glimpse frequency is required the observer uses an eyepiece tube T; a telescopic camera tripod forms a useful support. There are a number of special discs—samples are shown in Fig. 4—but the many incidentals in the shape of lamps, sparking coil and so forth used with the tuning fork make-and-break and otherwise cannot be enlarged upon here.

Needless to say the performance of the tuning fork is precisely known under whatever condition it operates—the addition of the wings for "edge" and "slit" vision, for instance, necessitating a certain negative correction to the scale indication given by the sliders. The amplitude of the tuning fork limbs is set by means of the indicator and by rheostatic control of the exciter coil "pull." The apparatus is stroboscopically calibrated against a fixed standard tuning fork, and in spite of the fact that it is portable and has received considerable rough usage a consistently high degree of accuracy is maintained. But both forks can be checked against a pendulum, the addition of a 10 : 1 gear on the phonic motor making it possible to count the revolutions and thus find the number of tuning fork vibrations in a definite period of pendulum time. Temperature and other errors are almost negligible, and as regards accuracy of test Dr. Drysdale can be quoted as placing results determined by the slit method so high as 1 part in 10,000; thus one has a useful margin.

Stroboscopic Observations.

It will be apparent that with such a testing set a large variety of stroboscopic effects can be made use of. The writer does not propose to enter into detail regarding them, as in every speciality the operator with any resource works out his own particular modifications. However, there is one interesting and novel example worthy of mention. Generally the use of a special observation disc of some kind is required. The disc is usually attached to the end of the shaft to be tested, but this is not always possible. In the case in point the machine was a Parsons' turbo-alternator of 10,000 kilowatts, the turbine end, of course, not being available, while the "electrical end"—the exciter—was also hidden owing to the fact that the rotor was water cooled—see Fig. 5. A steel shoulder on the exciter commutator, however, was seen to bear twenty-three screw holes upon its periphery and it was decided to make use of them.

The basic speed of the turbo-alternator was 2400 revolutions per minute, but actually the "system speed" was nearer 2440 revolutions per minute as a rule. Taking 40 revolutions per second as the speed, 920 screw holes would pass a point each second, and using a phonic motor rotating ten times per second an intercepting device with ninety-two holes would give 920 glimpses per second, and hence the stationary effect. Actually a glimpse frequency of half this value was adopted, and a disc having two series of holes, forty-six and forty-seven in number, was prepared (*vide* Fig. 4 A); therefore, with this disc and the tuning fork of variable frequency, speeds from 40.00 to 40.85 revolutions per second could be determined precisely by the stationary image method. The following are some figures obtained in the region of 5 p.m., when many thousands of kilowatts were being taken off the widespread system of supply; the frequency remains fairly stable.

Fundamental glimpse ~ = 470 per sec. (T.F. at 50.00 d.v.) equivalent to turbo-alternator speed of 40.87.

Time. p.m.	T.F.	Percentage from basis.	Speed (= frequency).
4.40	49.775	−.45	40.69
.43	49.70	−.60	40.63
.46	49.65	−.70	40.59
.48	49.50	−1.00	40.47
.50	49.525	−.95	40.49
.59	49.60	−.80	40.55
5.00	49.80	−.40	40.71
.01	49.85	−.30	40.75
.03	49.80	−.40	40.71
.04	49.75	−.50	40.67
.05	49.70	−.60	40.63

At 4.50 p.m. the frequency was measured by another method some miles away and found to be 40.45—a disparity of approximately 1 in 1000. (The speed indicator on the turbine indicated 2520 revolutions per minute!) Several incidental difficulties were met with. In the first place, the tuning fork base required a soft support owing to the interfering vibration of the engine-room. Then the phonic motor, which the writer had usually "phased in" by auditory means, could not be heard. Accordingly five holes were drilled in the glimpse disc—Fig. 4 A—and by observing the tuning fork through them the stepping-in speed could be found optically. It was noted that the screw hole images could only be observed when viewed through the side of the intercepting disc rotating oppositely to the machine; the reason is obvious, but the phenomenon was unexpected. Fig. 5 shows the apparatus in use, the special Fig. 4 A disc being in use and the tuning fork box resting on a coat.

On another occasion the speed of a Metropolitan-Vickers turbo-alternator set of 20,000 kilowatts was conveniently determined by utilising the two diametral keyholes on the shrounded shaft end; the basic speed was again 2400 revolutions per minute and a cardboard disc—Fig. 4 C—was improvised and attached by Chatterton compound to the phonic motor.

T. C. Richardson has suggested that in the case of a system or the like involving machines running at a common speed a convenient and simple method is available in the use of a tuning fork of the same periodicity, variable and fitted with observation wings, a simple mark on a rotating part being utilised.

Frequency Measurement.

The determination of the number of cycles per second on an alternating-current system is peculiarly possible by stroboscopic means. There is a definite connection between the frequency and speed of synchronous apparatus; the terms are interchangeable or of known relationship; the conditions are identical through the same supply system; and convenient use can be made at any point, not only of any form of synchronous device, but also of the blink effect given by a suitable illuminant connected to the supply. As a criterion of the "system speed" a small synchronous motor may be used; and, if its own design does not afford the necessary stroboscopic clues, an observation disc with suitable markings or figure combinations can be fitted. View interruption is given by direct or indirect use of a tuning fork as heretofore described. If the motor must be spun by hand it can be optically phased-in by also fitting an "Osglim" lamp or the like and adopting a suitable observation disc arrangement. In all probability the true supply frequency must needs be determined from percentage slip on the synchronous speed, but, if the fork is variable or a Tinsley strobometer (conical drum with roller contact device) be used in addition, the stationary effect can be ensured.

The writer reverses this procedure in using an observation disc driven at a standard speed and illuminated from the supply by an arc lamp, "Osglim" lamp or an ordinary lamp with the thinnest possible filament; but the stroboscopic images are never so clear, owing to the sluggish nature of the illuminant, though current rectification is an improvement. Fig. 4 D shows a disc with an eight and a sixty-five point star used on a 40 ~ supply. On one occasion when the datum speed for the recording tachometer in a governor test was required the writer connected his motor to the secondary leads of a current transformer in the alternator circuit and viewed the observation disc *viâ* the tuning fork wings.

Enough has been written, without further detail, to show the infinite variations possible.

Advantages Summed Up.

Stroboscopic methods are capable of a high degree of precision.

A testing set which includes a fundamental time element such as a tuning fork has negligible inherent errors and can retain a useful accuracy of at least .1 per cent. even if portable.

The speed range is practically indefinite.

Instantaneous speed determination is possible, precision indications being obtainable on acceleration and running-down tests (*c.f.* Professor D. Robertson's separation of no-load stray losses in a continuous-current machine in a running-down test).

No load need be placed upon the rotating part under test.

Peculiarly useful under alternating-current conditions—frequency determination and slip in induction motors.

Hunting and cyclic irregularities are observable and, to a certain extent, capable of study. Such effects are incidental to speed measurement, but nevertheless important.

The Makhonine Motor Fuel Process.

The curiosity aroused by the experiments carried out by the military authorities in France with an apparatus invented by a Russian engineer, M. Makhonine, for producing motor fuels from all kinds of crude mineral, vegetable and other oils, was stimulated by the secrecy that was observed as to the character of the process. The trials were effected at Vincennes on some of the heaviest tanks, and they were declared to have given remarkable results from the point of view of economy, while the advantage of the system, particularly for the purposes of national defence, lay in the possibility of employing any kind of oil for the working of internal combustion engines of every description. On the conclusion of the trials at Vincennes, M. Makhonine offered a free licence to the Government for the application of his system to military purposes. The process therefore received considerable publicity, and it was announced that the system was destined to effect great changes in heavy road traction, while the possibility of locomotives using the "Makhonine liquid" superseding electric locomotives was seriously considered. There was certainly some controversy over the value of the system, but no one could give any definite opinion in the absence of particulars of the new invention. An idea of what constitutes this invention can now be gathered from the patent specification, which has just been published. It is disclosed that the plant employed really consists of an apparatus for distilling crude oils, and condensing the vapour before admission into the engine. The reservoir is in the form of a boiler heated by any suitable means, such as by the engine exhaust, burners or electricity, or by vaporisation under pressure. The fuel can be employed either in the form of vapour entering directly into the cylinders or of a liquid produced by the condensation of vapour and passed through the ordinary type of carburetter. There are, of course, several variants in the specification. Although M. Makhonine may have departed considerably from the details of the patent specification, it is clear that the distilling plant is necessarily bulky, and that for the quantity of spirit produced there will be a large volume of by-products. This is obviously a difficulty which M. Makhonine is endeavouring to overcome, for it was stated recently that he was pursuing his researches in the direction of adapting the system to smaller vehicles. For the moment, however, a process for distilling crude oils on the vehicle itself does not seem to justify the enthusiasm with which the invention has been received in France. Its application is obviously limited to the heaviest types of vehicles, and it has yet to be proved that the invention will show any appreciable advantage in view of the progress that continues to be made with the crude oil engine.

Hydro-Electric Schemes in Alsace.

The project for the construction of a canal alongside the Rhine, which is to facilitate navigation between Basle and Strasburg and will permit of the laying down of hydro-electric installations capable of producing an average total of 785,000 horse-power, has made a step in advance by the Swiss authorities sanctioning the first stage of the undertaking between the frontier and Kembs. This sanction has only been obtained after long and arduous negotiations, owing to the proposed barrage raising the high-water level of the Rhine as far as Basle. Arrangements had to be made to ensure the reconstruction of a part of the drainage system of the Swiss town at the expense of the French company so as to avoid any risk of flood. It is also affirmed that much of the opposition to the canal scheme came from the Swiss electrical companies, which would obviously lose the business they are now doing in electrical distribution across the frontier. Another reason for the lack of enthusiasm shown by the Swiss was their preference for the canalising of the Rhine, which they hoped to effect by the method that has proved successful elsewhere of creating artificial sandbanks with stakes and brushwood so that the current of the river would open up a deep though tortuous channel. This scheme has been strongly criticised on the ground, principally, that the velocity of the river and the narrowness of the channel would render navigation from Strasburg to Basle very difficult. The canal, on the other hand, would permit of larger tonnage boats being navigated under safer conditions and at a higher average speed. The fact of the Swiss authorities having sanctioned the construction of the barrage across the Rhine proves their acceptance of the French canal scheme, and it now only remains for the French Parliament to confirm the concession which the Government granted to the Société des Forces Motrices du Haut-Rhin to allow of the company starting upon the construction of the section from the frontier to Kembs, where the first hydro-electric installation is to be laid down.

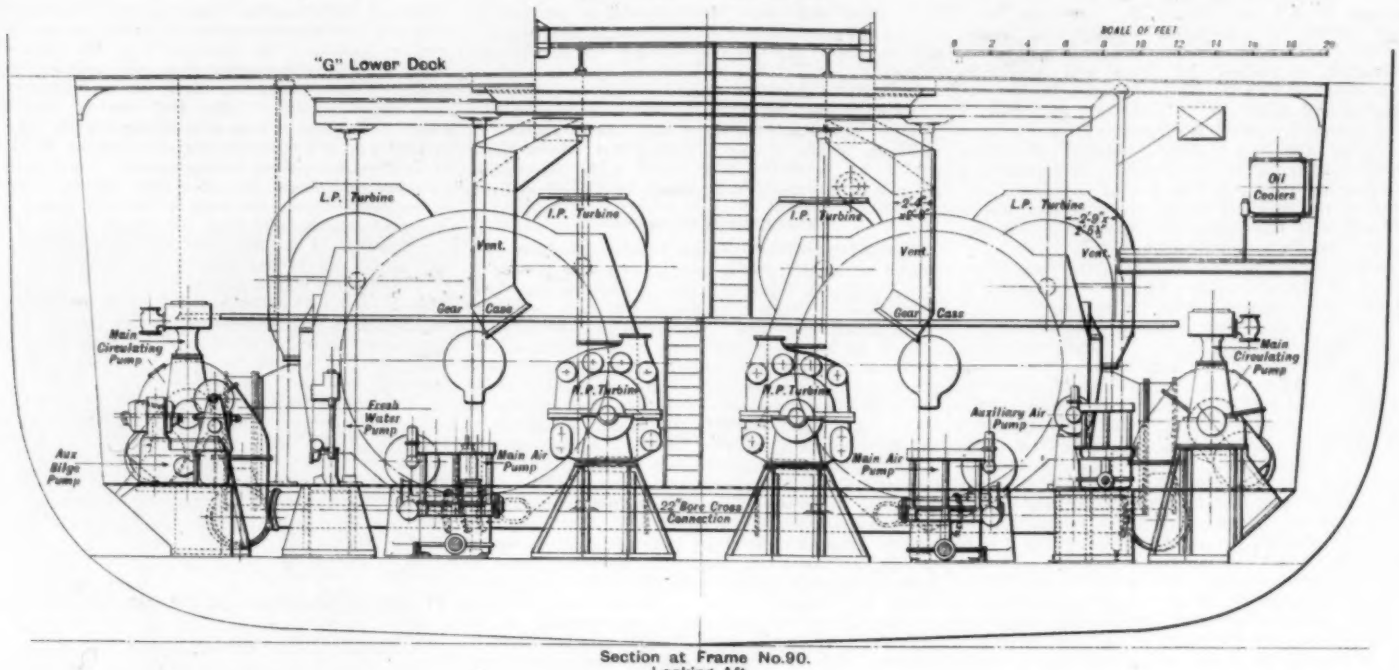
The scheme consists in the construction of a barrage across the Rhine about 3½ miles from the Swiss frontier. It will raise the low-water level by 8 m. and the high-water level by 4 m., while in times of flood the opening of sluice-gates will allow of the water flowing under normal conditions. The barrage will be constructed of piers with Stoney superimposed sluice gates, the width of the central openings being 30 m. and of the end openings 17.50 m. The canal will start from the Rhine about 500 m. above the barrage and will have a length of a little more than 3½ miles. It will have a width of more than 120 m. at the surface and a depth of 11 m. to 12 m. The volume of water passing through the canal will, of course, be regulated by the barrage sluice gates and by the requirements of the turbines. The Francis turbines are of the vertical type, each of about 12,000 horse-power. In the event of a turbine stopping a sluice gate will open automatically to allow of the passage of a corresponding volume of water. By the side of the generating station a lock 185 m. long and 25 m. wide is to be constructed, and if that be found insufficient for the traffic a second lock 100 m. long will be made. From here the canal bends round and falls into the Rhine. The average head of water at the turbines during ten months of the year is 13.20 m., and the energy produced will be an average of about 120,000 horse-power.

This section will constitute the first part of the Alsace Canal, which will be composed of seven similar sections, each with a hydro-electric installation and each flowing into the Rhine through a short bend, so that as each section is completed it will be put into service while the remaining part of the waterway is being constructed. The total length of the canal will be 69 miles, or 4½ miles shorter than the course of the river. At the first three generating stations at Kembs, Ottmarsheim and Fessenheim the head of water at the turbines will be from 13.20 m. to 14.20 m.; at Vogelgrun, Markilsheim and Sundhouse it will vary from 11.70 m. to 12 m.; and at Gertsheim and Strasburg the head will be 10.90 m. The supply from all the stations, which will, it is estimated, amount to some 785,000 horse-power, will be connected up with the general distribution scheme in the north-eastern departments of France.

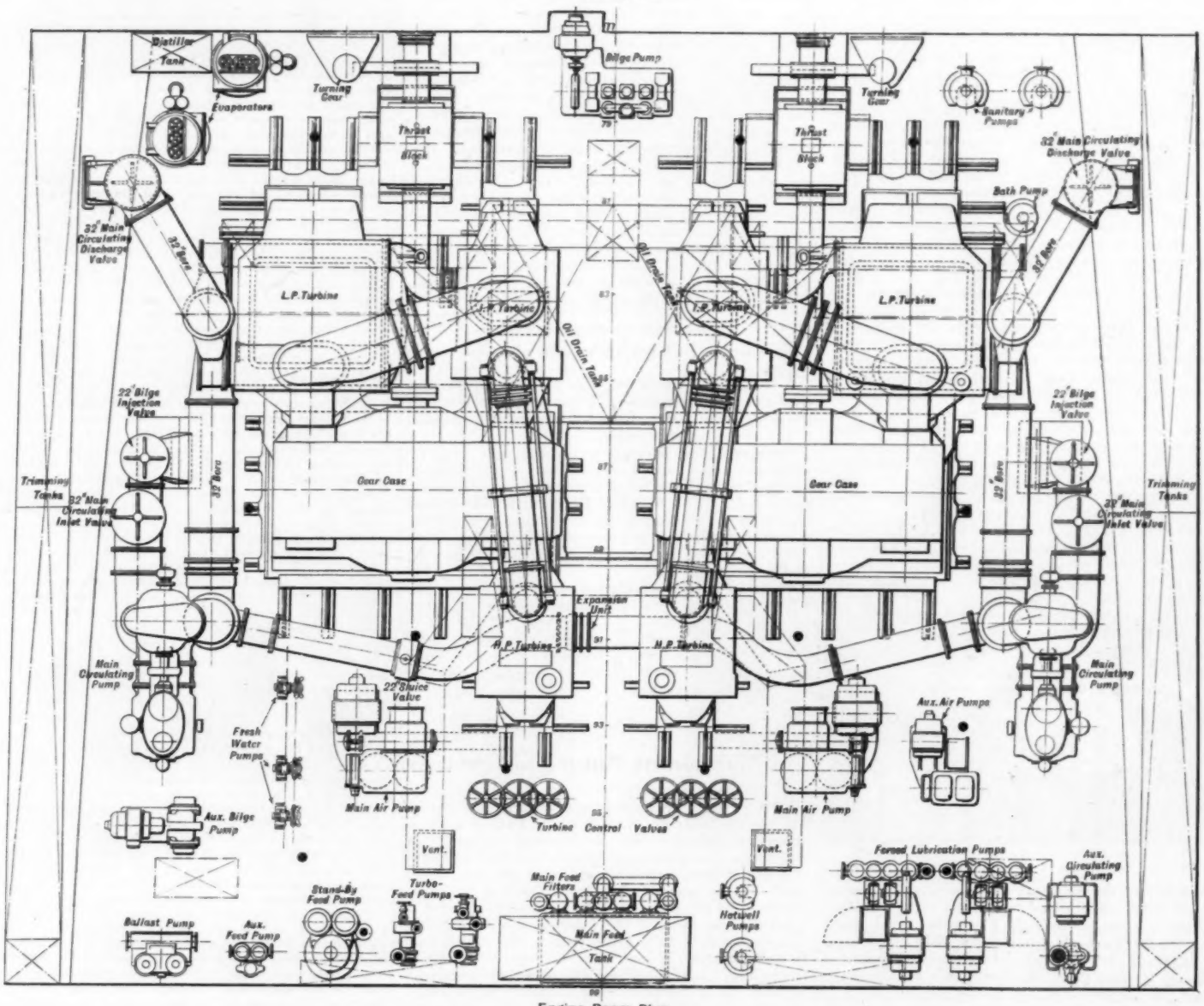
THE ENGINE ROOM OF THE ORIENT LINER ORONSAY

JOHN BROWN AND CO., LIMITED, CLYDEBANK, BUILDERS AND ENGINEERS

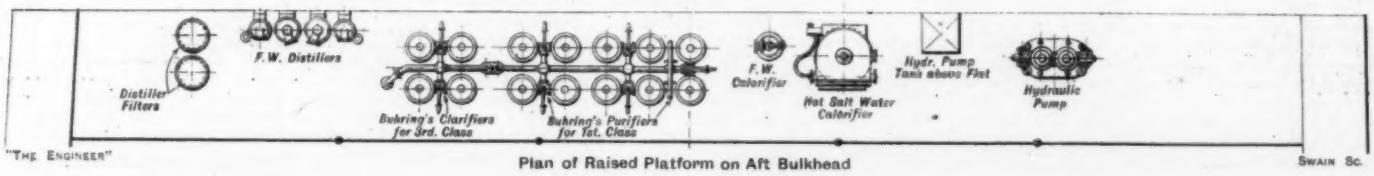
(*For description see opposite page*)



Section at Frame No.90.
Looking Aft.



Engine Room Plan



Plan of Raised Platform on Aft Bulkhead

"THE ENGINEER" SWAIN Sc.

The Orient Liner Oronsay.

No. II.*

MAIN PROPELLING MACHINERY.

THE propelling machinery of the Orient liner Oronsay consists of two sets of Brown-Curtis steam turbines driving twin propeller shafts through single-reduction gearing, as shown by the drawings reproduced on page 212. The main turbines and gearing were constructed entirely in the Clydebank works of John Brown and Co., Limited, whilst the propeller and turbine shafts, as well as other large forgings, were made in the company's works at Sheffield.

Each set of machinery comprises three separate units, the high-pressure, intermediate and low-pressure turbines respectively, which are so grouped that each turbine drives its own pinion through a flexible coupling. All three pinions engage with a common main gear wheel. The drawing reproduced below—Fig. 12—is a sectional plan and elevation of the port turbine, with its gearing and gear case. On the right hand of the drawing a diagrammatic end view shows the relation of the three driving pinions to the main gear wheel. It will be noted that the high-pressure turbine is placed at the forward end of the unit, and below the centre of the main gear wheel, so that it stands at a convenient height above the engine-room floor level. The intermediate and low-pressure turbines, on the other hand, are placed at the aft end of the unit above the centre of the gear wheel. Each of the casings for these turbines is supported on a raised seating, which gives room beneath the low-pressure turbine for the underslung surface condenser placed athwartships. A high-pressure astern turbine is incorporated with the intermediate pressure ahead turbine, and the low-pressure astern turbine is built into the main casing of the low-pressure ahead turbine.

The three turbines run at a normal speed of 1520 revolutions per minute, which is geared down to a propeller speed of 90 revolutions per minute. Four-bladed propellers are fitted. They have manganese bronze blades attached by steel studs to a cast steel boss and revolve outwards. Under normal steaming conditions the two sets of machinery develop about 20,000 shaft horse-power, while, when going astern, power up to about 75 per cent. of the output is available.

Gears and Gear Casing.—The double helical toothed gear wheel has 592 teeth, with a diameter over the tips of 174.24in., and a pitch circle diameter of 173.84in. Its total width of face is 50in., and the teeth have a normal pitch of 0.8in., a circular pitch of 0.922in., and a spiral angle of 29 deg. 58.05 min. The pinions have thirty-five teeth, with a diameter over the teeth of 10.67in., a pitch diameter of 10.27in. and a total width of face of 50in. They are made from nickel steel forgings. Referring to the drawing—Fig. 12—it will be seen that the main gear wheel has a centre part, which is made of cast iron, on to which the two mild steel rims which carry the teeth are shrunk and pinned. The substantial character of the gear case, the generous proportions of the main journal bearings, and the flexible couplings between the turbines and the pinions may be noted. The adjusting blocks and the propeller thrust blocks are of the Michell type. All bearings have forced lubrication fittings connected to the main lubricating system, which works under a head, and is supplied from gravitation oil storage tanks placed in the engine-room hatch. Two motor-driven geared pumps, of the Weir type, draw the oil from a drain tank fitted beneath the engine-room floor—see Fig. 11—and deliver it through strainers and coolers to the gravity tanks, whence it flows to all the main bearings of the turbines and gears, and also supplies the sprayers which direct the oil between the teeth of the gear wheels and pinions. We noted that special fittings, with electric illumination, are placed on the gear-box to indicate the flow of oil.

Arrangements are made whereby oil may be by-passed from the main tanks and delivered directly from the pumps. In normal service only one set of pumps is required, and the other serves as a stand-by set. A de Laval type centrifugal oil purifier is fitted in the engine-room for treating the lubricating oil, and additional lubricating oil storage tanks are fixed in the shaft tunnel.

Condensing Plant and Pumps.—The condensing plant is designed for a working vacuum of 28in. and a boat-shaped condenser of the underslung type is bolted directly to the exhaust flange of the low-pressure turbine. It has a total surface of about 11,000 square feet. The condensate is dealt with by two motor-driven geared air pumps of the Weir Paragon type, which are placed one on either side of the main turbine control valves. A vacuum augmentor and an auxiliary air pump are also fitted. The air pump discharges the condensate to a hotwell tank, from which the feed passes through filters, and is raised by motor-driven centrifugal Drysdale hotwell pumps to a Weir direct-contact feed heater, installed just above main deck level in the engine-room hatch. The hotwell pumps are in duplicate, and each is designed to deal with the total feed water required at full power rating. Duplicate main turbo-feed pumps of the Weir type draw the feed water from the heater and deliver it to the boilers. Both the centrifugal hotwell pumps and the turbo-feed pumps are controlled by float gear arranged on the feed heater and the hotwell pumps are, in addition, controlled by float gear in the hotwell tank. As well as the main turbo-feed pumps, two auxiliary feed pumps of the Weir direct-acting steam-driven type are fitted, one of which acts as a stand-by for the turbo-feed pumps, while the other is used when the vessel is in harbour.

The drawings reproduced on page 212 and in Fig. 12 show the arrangement of the circulating pumps, valves and piping. The pumps are driven by enclosed compound steam engines, and were built by W. H. Allen, Sons and Co., Limited. A small motor-driven circulating water pump, by the same makers, supplies the auxiliary condenser placed on the forward bulkhead over the main feed tank.

The other pumps in the engine-room are arranged along the forward and aft bulkheads, and include two sanitary pumps and one bath pump of the Drysdale vertical motor-driven centrifugal type, and a vertical triple plunger motor-driven bilge pump, by J. H. Carruthers and Co., Limited, of Polmadie, Glasgow. The same firm supplied a duplex auxiliary bilge pump and a duplex steam-driven fire and bilge pump, which are installed in the boiler-rooms. Other Carruthers pumps include three fresh-water pumps of the Simplex steam-driven type in the engine-room and a geared motor-driven emergency bilge pump in the refrigerating room.

On the aft bulkhead of the main engine-room there is a raised platform—a plan of which is shown at the bottom of page 212—on which various auxiliaries are placed. These include the fresh and salt water calorifiers, distillers and filters, and sets of Buhring's purifiers and clarifiers for the first-class and third-class water supply. Another machine on this platform is an hydraulic pressure pump for the Brunton type water-tight doors, which takes its water from a tank placed above the platform.

Workshop.—The engine-room workshop is equipped with a lathe, drilling machine, grinding wheel and other engineers' tools, which were supplied by Dempster, Moore and Co., Limited, Glasgow.

Electrical Generating Plant.—At the same level as the platform just described, but at the forward end of the engine-room, is a separate compartment for the auxiliary generating plant. In it three 400-kilowatt, 220-volt turbo-generating sets, built by W. H. Allen, Sons and Co., Limited, are installed. The turbines are of the impulse type, and run at a speed of 5000 revolutions per minute. They drive the generators through double reduction helical gearing. Dry saturated steam is delivered to the turbine stop valves at a pressure of 200 lb. per square inch, and the turbines exhaust to the feed heater at a back pressure of 25 lb. per square inch absolute. The main switchboards are arranged on the port and starboard sides of the machinery compartment, and a central panel on the after bulkhead is provided for the change-over switches. The ship is wired throughout on the two-wire insulated system. All the motors for driving the pumps and other auxiliaries were supplied by Allens, of Bedford, which firm also made the 36-kilowatt hot-bulb engine and generator fixed on the boat deck level. Special arrange-

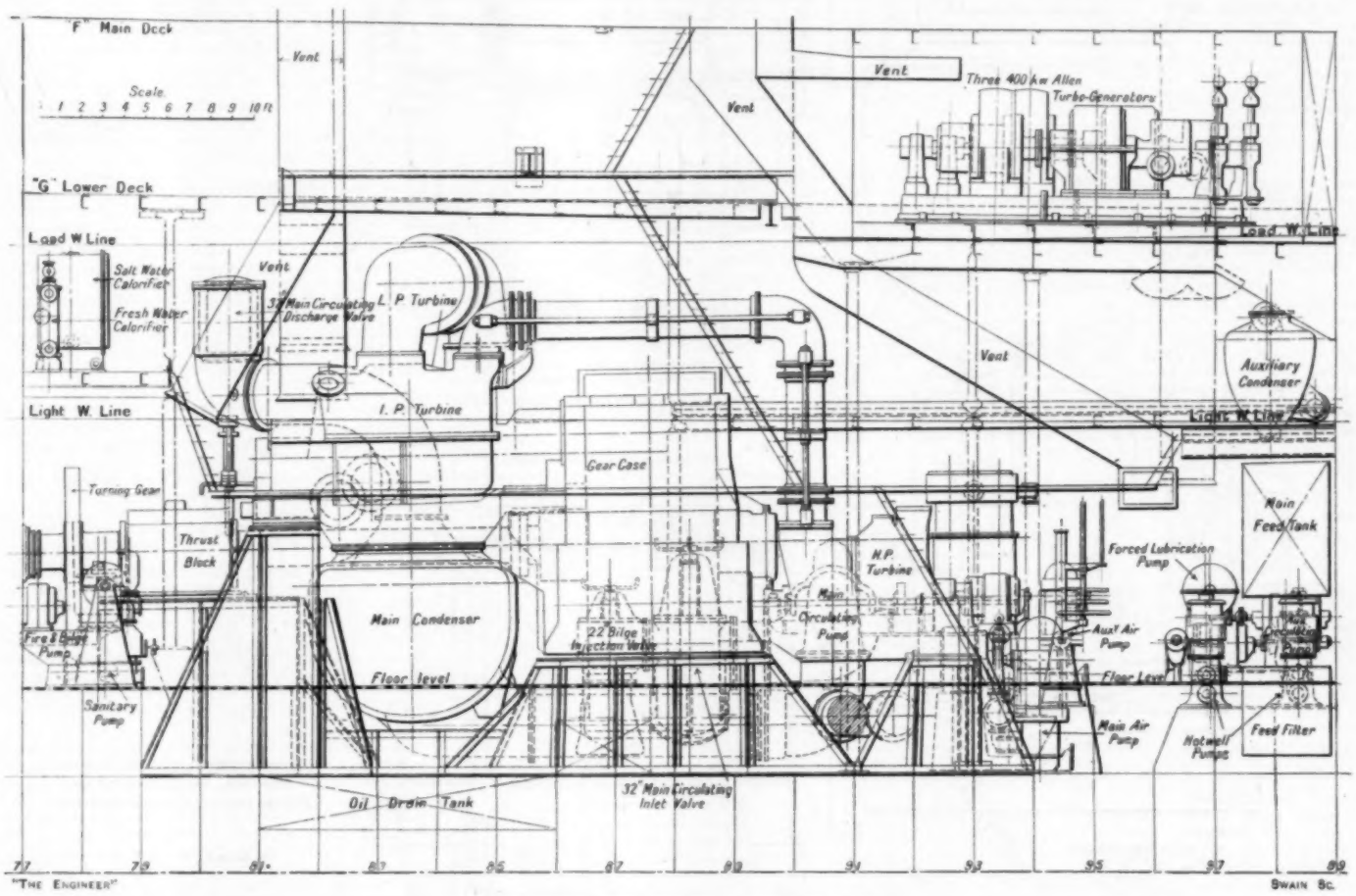


FIG. 11—LONGITUDINAL SECTION OF ENGINE ROOM

* No. I. appeared February 13th.

ments are made for supplying cool air to the engine and dynamo rooms by means of appropriately arranged vents.

Boiler Equipment.—Steam is supplied to the main and auxiliary turbines by six double-ended and four single-ended multitubular return-tube boilers contained in two separate rooms. The boilers are 16ft. 1in. in diameter, with a length of 21ft. 7½in. for the double-ended and 11ft. 1½in. for the single-ended types. Separate combustion chambers are which are placed in each boiler-room. Any combination of two of these sets gives sufficient capacity for the whole boiler duty at full power. There are four oil settling tanks, two in each boiler-room, and Weir type motor-driven oil fuel transfer pumps draw the fuel oil from the double bottom tanks and discharge it to the settling tanks. The distilling and evaporating plant, which was also made by G. and J. Weir, Limited, comprises two 50-ton evaporators with automatic feed and brine ejectors, and two distillers, each them to be examined when it becomes necessary to do so.

The machinery and boilers we have briefly described were constructed by the builders to the requirements of the Board of Trade for passenger certificate, and in full accordance with the requirements of Class 100 A 1 at Lloyd's under special survey. The installation was supervised by Mr. J. Peacock, the superintending engineer of the Orient Line, who, with Mr. F. Walker, the company's naval architect,

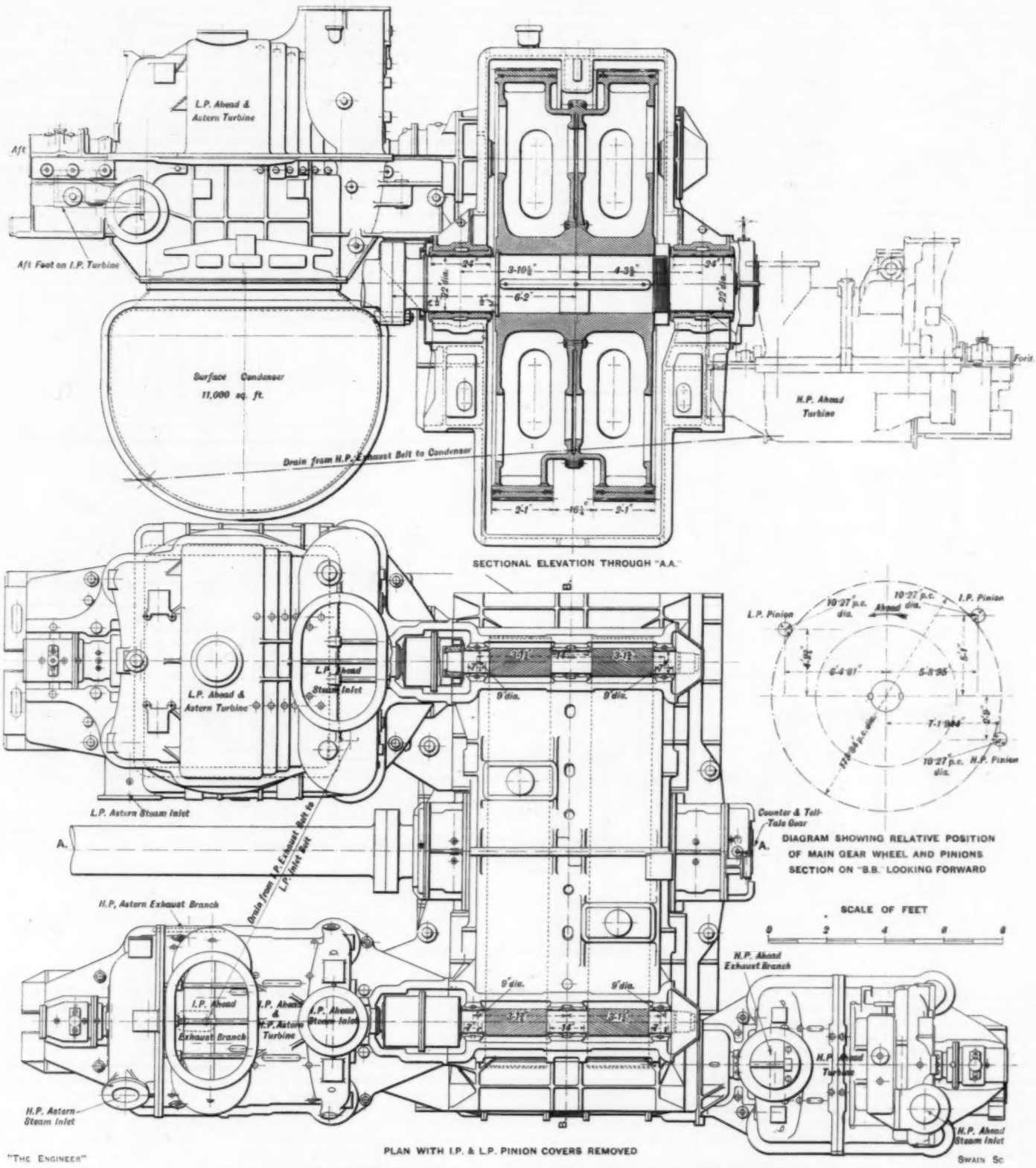

L.P. Ahead & Astern Turbine
Aft
Aft Foot on I.P. Turbine
Surface Condenser 11,000 sq. ft.
Drain from H.P. Exhaust Belt to Condensor
H.P. Ahead Turbine
Fore
SECTIONAL ELEVATION THROUGH "A.A."
L.P. Ahead & Astern Turbine
L.P. Ahead Steam Inlet
L.P. Astern Steam Inlet
Drain from I.P. Exhaust Belt to I.P. Inlet Belt
H.P. Astern Exhaust Branch
I.P. Ahead Exhaust Branch
I.P. Ahead & H.P. Astern Turbine
I.P. Ahead Steam Inlet
H.P. Astern Steam Inlet
PLAN WITH I.P. & L.P. PINION COVERS REMOVED
L.P. Pinion
I.P. Pinion
H.P. Pinion
Counter & Tail-Tale Gear
DIAGRAM SHOWING RELATIVE POSITION OF MAIN GEAR WHEEL AND PINIONS
SECTION ON "B.B." LOOKING FORWARD
SCALE OF FEET
H.P. Ahead Exhaust Branch
H.P. Ahead Turbine
H.P. Ahead Steam Inlet
"THE ENGINEER"
SWAIN SC

FIG. 12—SECTIONAL ELEVATION AND PLAN OF THE PORT TURBINE AND GEARING

fitted to all the furnaces, which are of the Deighton type, each double-ended boiler having six furnaces and the single-ended boilers three. The working pressure is 215 lb. per square inch, and are grouped in two separated boiler-rooms. In each room there are three double-ended and two single-ended boilers, with uptakes to the elliptical funnel arranged over each room.

The fan rooms are arranged above the boilers, and six sets of Howden's double inlet electrically-driven fans are installed.

The furnaces are fitted with the Todd oil-burning system, in conjunction with Howden's hot-air forced draught. The oil pressure pumps, heaters and filters are grouped into four separate plants, two of designed for an output of 25 tons of water per twenty-four hours.

Refrigerating Machinery.—Forward of the boiler-rooms is the refrigerating machinery compartment, in which three CO_2 compressors, by J. and E. Hall and Co., Limited, of Dartford, are installed. Each of these machines is driven by a 92 brake horse-power motor, through reduction gearing, and the installation is designed to meet the requirements of the insulated cargo holds and the refrigerated store rooms, and to supply the ice required in the ship. A useful feature of the installation is the provision of a duct keel beneath the refrigerating compartment, and the two insulated spaces immediately forward, which carries the necessary pipes under these spaces, and permits has been intimately associated with the designing and building of the two 20,000-ton liners recently placed in service. The results of the first ship, the Orama, were outstanding in the important matter of economy of fuel, and there is little doubt that the Oronsay, which we have described in these articles, will prove of equal excellence as regards economy in running and in popularity among the liners in the Australian service.

IT is announced that on April 6th the Great Western will restore the 3.30 p.m. Paddington to Plymouth and the 6.20 p.m. Plymouth to Paddington. In pre-war days the former ran non-stop to Exeter.

Railway Matters.

THE stations at Torquay and Paignton are being so arranged that down trains will be able to arrive at either the down or the up platform.

IT is announced that Mr. J. G. B. Sams, formerly of the Great Eastern Railway, has been appointed locomotive assistant on the Jamaica Government Railways.

A VIGOROUS campaign in support of the "Safety" movement on the Great Western opened with the beginning of the present year, and in the first fortnight there was, as compared with the corresponding period of 1924, a reduction of 22 per cent. in the number of accidents reported by railway servants. The actual figure was 252, as against 324.

SOME particulars appeared in the Press last Saturday of the day colour light signals, which, as announced in this column on January 16th, are to be installed on the Southern Railway at Charing Cross, Cannon-street, Holborn, Ludgate-hill and St. Paul's. They are to have the fourth aspect, given by two yellow lights, when the full braking distance is not available.

THE vacancy created by the resignation of Mr. W. T. Weekes in the position of stores superintendent to the London and North-Eastern Railway, has been filled by the appointment of Mr. G. F. Thurston. Mr. Thurston was formerly the secretary to the Great Eastern, and when the London and North-Eastern was formed, he and Mr. J. McLaren, of the North British, were made joint secretaries.

THERE are now 600 battery-operated signals on the Great Western Railway. The advantages of such signals are :—They can be fixed at any distance from the signal-box and therefore in the best position for the driver's view; they give accurate "on" and "off" positions, *i.e.*, do not droop and so give ambiguous indications; there are no heavy weights for the signalman to lift; nor wires for him to adjust to suit variations in temperature.

THE London and North-Eastern covers the distance between King's Cross and Bradford in less than four hours and gives a much faster service than does the London, Midland and Scottish. From March 2nd the latter company will have an express that will leave Bradford at 9.10 a.m., call at Sheffield and Leicester only, and be due at St. Pancras at 1.25 p.m. A corresponding train will leave London at 4.55 p.m. and be due in Bradford at 9.10.

A VERY salutary step was taken by the London Electric Railways Company lately when it prosecuted a passenger for attempting to enter a train at a tube station whilst it was in motion. The gate on the car had been closed by the conductor, but the man clung to the gate. The emergency brake was applied by the conductor, and the train stopped; otherwise the passenger would undoubtedly have been crushed between the train and the tunnel.

THE American Railway Association has completed plans for an exhaustive investigation of power brakes and appliances for operating power brake systems. The investigation, the cost of which will be borne by the American Railway Association, will be conducted by Harley A. Johnson, assistant general manager of the Chicago Rapid Transit Railway, who, as director of research, will employ such assistants as may be necessary for conducting the work.

DURING the last fifty years four cases of trains overthrown in gales have been inquired into by the Board of Trade—now the Ministry of Transport. In January, 1884, there were two such accidents on the same day, one at Letterkenny and one at Stranorlar, and in November, 1898, one on the Tralee and Dingle Railway. In the last a passenger was killed. The most serious was on the Leven Viaduct, when, on February 27th, 1903, the whole of the Furness down mail, except the engine, was thrown on its side.

THE removal of the statue of Eros from Piccadilly-circus has been made necessary by the reconstruction of the London Electric Railway Company's station there. Since the present station was opened in 1906, the number of passengers has grown from 1½ to 18 millions per annum. The new station will be 15ft. below the ground level, and oval in shape. It will have a large circulating area, whence no less than nine escalators will join the platforms. There will be a broad subway which may be used by the public, and smaller subways giving connection with seven parts of the Circus. The new station will be able to deal with 50 million passengers yearly.

THE resignation, owing to continued ill-health, of Mr. J. E. Charnley, the manager and secretary of the Cheshire Joint Committee's lines, might have opened up a novel situation as to the appointment of his successor. These lines were jointly owned by the Great Central, Great Northern and Midland, and when vacancies have occurred in the managership, the selection, in order to obtain a disinterested party, has been made from outside those companies. Mr. Charnley came from the Lancashire and Yorkshire, and his predecessor, Mr. J. Pinion, from the Belfast and County Down. Under grouping, the choice is now somewhat restricted, but the difficulty on this occasion has been met by the promotion of Mr. W. H. Oates, the assistant to the manager.

ASKED by Mr. Kennedy, the Labour member for Kirkcaldy, if he was satisfied that the number of attendants and platform staff employed on the City and South London was sufficient to ensure public safety in the opening and closing of carriage doors, Colonel Ashley replied that the inspecting officers of railways had had the pneumatically operated doors referred to under close observation during the three or four years they had been in use on the Underground Railways, and they were satisfied that safety requirements were fully met. He had, however, brought the points raised by the hon. member to the notice of the railway company, which stated that the use of the doors had been free from accident, and had proved in other respects satisfactory, particularly in allowing considerably improved doorway accommodation to be afforded and thereby reducing congestion when passengers entered and left the trains. The company stated further that the action of the doors was fully safeguarded, and that the staff employed was, in its opinion, quite adequate.

Notes and Memoranda.

THE United States Bureau of Mines recently announced that experiments at its Seattle station in the production of sponge iron had reached the "point where it is believed that industrial applications of the process can be safely considered for the production of sponge iron as a metallurgical re-agent for precipitation of copper, lead and numerous other metals from solution."

IN the course of a paper on tar distillation, read before the London Section of the Society of Chemical Industry, Mr. C. O. Condrup mentioned a novel method of breaking up pitch in the pitch bay. A chain is arranged along the floor of the bay before the pitch is admitted, and is hauled up by means of a travelling winch, when the pitch has solidified, with the result that the whole of the pitch is broken up into lumps of convenient size, so that it may be removed with ease and without the vast amount of labour ordinarily involved.

THE problem of keeping indicating instruments clean and readable in boiler-rooms has been solved by the Merchants' Heat and Light Company at its Indianapolis plant in a simple manner. Instead of mounting the various glass pressure gauges near the side walls, where they cannot be easily read at a distance, this company has grouped the instruments in a neat glass-covered vertical box, 24in. by 18in. by 4in., the entire background of which is painted white. The glass cover thus keeps the instruments clean. Under this arrangement firemen can readily ascertain what the air pressures are.

THE Swedish Iron Office has decided to grant a subvention of 25,000 kroner to the Uddeholm Company for the experimental production of steel direct from iron ore, according to the method invented by the engineer M. Flodin. The Office has under consideration an application from the Sandviken Ironworks for a subvention towards the exploitation of another method for the direct production of steel, invented by the engineer M. Martin Wiberg. Both methods are said to be economical, the only difficulties encountered being in their adaptation to production on a large scale.

WHEN the silkworm cocoon is stripped of the silk the chrysalis is usually thrown away in China as waste or is used to feed pigs. It is occasionally used for human food, but only a few people like the taste and it has never gained popularity. Industrialists in certain silk-producing areas in Szechwan province, including Shunking and Tungchwan, have now found that the silkworm chrysalis contains a high percentage of oil, which can be extracted by pressing. The crude oil thus extracted requires further refining before it can be used for food. It does not taste so good as other edible oils, but is an excellent ingredient for soap making. Several chrysalis oil presses are now being worked at Shungking and Tungchwan. One catty (1⅓ lb.) of dried chrysalis yields 4 oz. of oil. The residue after the oil has been extracted contains phosphorus and can be used as a fertiliser.

LECTURING recently on the subject of "Iron in Antiquity," before the members of the Birmingham and Midland Section of the Society of Chemical Industry, Dr. J. Newton Friend said that bronze instruments were used by man long before he realised they were alloys, and we knew that other metals were appreciated even in the Stone Age. In fact, in the Bronze Age man had reached a very high stage of mechanical skill. From the Bronze Age most nations went to the Iron Age, but some nations passed directly from the Stone Age to the Iron Age. Iron was in use in India practically 4000 years ago, and although it was known also to the early Egyptians, preference was given by them to bronze weapons. Homer was acquainted with iron. Homeric heroes fought with bronze weapons, while wrought iron was regarded as among the treasures of the wealthy. In the early days man found bronze more satisfactory than iron as material for the making of weapons. The Romans were skilled metallurgists, and were actually the first to prepare cast iron. Our ancestors, said Dr. Friend, used iron for their currency.

IT may be doubted, stated Dr. Russell in his recent presidential address before the Junior Institution of Engineers, whether the present generation works harder than the last, but, at any rate, it works at a much higher speed, and all kinds of devices are used to accelerate its rate of working. Whether this movement is altogether for the ultimate benefit of the human race is a moot question, but that it exists everyone knows who has had experience of modern business methods. The incentive is the increase of profits that comes from doing an increased volume of work in a given time, by the aid of machinery. Speed and haste have very different meanings, and if the quality of the work does not suffer by the higher rate at which it is done, then the increase is beneficial, especially when it increases the time of the worker for exercise and recreation. Nowadays we go for a car ride to John o' Groats with no more trepidation than we experienced in the old days in going for a drive to Windsor. Amongst the devices for speeding up business, automatic telephony and printing telegraphy, or teletyping, will play a prominent part in the future.

ENCOURAGED by the success attending the operation of its two Diesel electric tankers now in use, the Standard Oil Company, of California, has decided to place an order for another tanker of like kind, which it proposes to use in the San Francisco-Hawaiian trade. In this vessel, however, the engine-room will be amidships, instead of aft as in the two former ships. Two 245-kilowatt Diesel-driven generators will normally operate in series, and a 30-kilowatt generator is to be included in each set for excitation purposes and auxiliary power. Propulsion will be effected by one 600 horse-power 130 revolution per minute motor, driven by the main generators. The auxiliary generators will operate alternately, one acting as a stand-by for the other. In addition to the propulsion equipment, electric power is used for auxiliaries above and below decks. All the electrical machinery is to be made by the General Electric Company, of America. Below decks electric power will drive the ventilating and pumping apparatus, and a five-kilowatt generator will carry the auxiliary lighting load. The deck auxiliary machinery will also include various motor equipments.

Miscellanea.

A SCHEME has been prepared for the construction of a 25,000 horse-power plant at the junction of the Nymboida and Mann rivers in New South Wales.

THE Ebbw Vale ironstone mines in Northamptonshire, after being closed down for two years, are being opened during the present month, orders for substantial deliveries being in hand.

THE Air Ministry announces that "Wakefield" Scholarships, amounting to £75 each, have been awarded to Flight Cadets John Clarke and R. J. Drummond-Brown, and the "Hyde Thomson" Memorial Prize, amounting to about £32, has been won by Flight Cadet C. W. Cooper.

THE announcement is made that James Hopwood Jeans, M.A., D.Sc., LL.D., F.R.S., Secretary of the Royal Society, and Sir William Henry Ellis, G.B.E., have been appointed by Orders of Council dated respectively January 28th and February 4th, 1925, to be members of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research.

THE Royal Automobile Club is arranging for a demonstration of all anti-dazzle headlamps and devices which have at any time been tested by it. The date fixed for the demonstration, which will take place in Richmond Park, is February 24th and the time of assembly 8.30 p.m. The arrangements will include a demonstration of the R.A.C. method of testing, using the standard disc.

THE latest return made by the National Federation of Iron and Steel Manufacturers shows that the production of pig iron in January amounted to 569,400 tons, compared with 580,300 tons in December and 636,600 tons in January, 1924. The furnaces in blast at the end of January numbered 172, a net increase of 5 since the beginning of the month, 10 furnaces having been blown in and 5 damped down or blown out. The production includes 188,100 tons of hematite, 161,800 tons of basic, 156,900 tons of foundry, and 30,000 tons of forge pig iron. The output of steel ingots and castings amounted to 605,100 tons, compared with 551,000 tons in December and 894,300 tons in January, 1924.

ACCORDING to the *Commonwealth Engineer*, a scheme has been drawn up for the improvement of the water supply to the districts of Wollongong and Port Kembla, New South Wales, by granting an additional supply from the new Cordeaux reservoir. The cost of this scheme is estimated at £200,470. As this suggestion will deplete to a certain extent the metropolitan area supply, it is proposed that a new scheme shall be adopted for the purpose of using the Woronora catchment for the purpose of supplying portions of the area at present supplied from the Prospect reservoir. The plant and organisation at the Cordeaux dam is recommended for removal to the Woronora dam, the site of which has already been selected.

PRIDE of place in the Palace of Engineering at Wembley will be given this year to a great display of housing, which is being organised by a Committee, of which the Minister of Health, the Right Hon. Neville Chamberlain, is president. Its purpose is to show the practical uses to which the various new methods and materials now recommended for the building of houses can be put. Side by side with the display of houses will be exhibits devoted to such important details as heating. It is hoped that the railway companies will stage large transport exhibits in which will be shown the results of 100 years' progress, and there will be a representative display of water transport, in which the most important of the big steamship companies will take part.

FIVE Russians have arrived at New York to study American methods of ore mining and metal manufacture. Two of the visitors are directors of the Uralplatina, two are representatives of the Machinery Construction Trust of Leningrad, while the fifth member of the party represents the Supreme Council of Public Economy, and is also a director of the State ore industry. These experts will spend three months in the United States studying methods of production with a view to placing orders for equipment. They will inspect some of the larger works where dredgers and other mining equipment which might be introduced in the platinum fields of the Urals are constructed. In addition, orders are contemplated for the needs of the rehabilitated heavy industries and for the re-equipment of the factories.

PARTICULARS of what is called a "coke competition" appear in the current issue of the *Gas Journal*. The object of this competition is to endeavour to pool from all parts of the world experiences and the results of research with the view of—if economically feasible—improving gas coke qualitatively, and preparing it in the best condition for the purposes to which it is applied. The competition has been made possible through the generosity of the Woodall Duckham Companies, which have subscribed £1000 to be distributed as prizes; and they have left the organisation of the competition entirely in the hands of Mr. Arthur F. Bezant, whose colleagues on the adjudicating committee will be Mr. A. W. Smith, general manager of the Birmingham Corporation Gas Department, and Mr. W. B. Leech, engineer of the Beckton Gasworks of the Gas Light and Coke Company.

AT a conference held on January 22nd, between the members of the Provincial Cabinet and Sir Adam Beck, chairman of the Ontario Hydro-Electric Power Commission, it was decided to urge the Dominion Government to take action to enable the Province of Ontario to proceed immediately with the St. Lawrence River power development. The project has been delayed because the Ottawa Government has not yet given its approval to the plans which have been submitted to it by the Hydro-Electric Commission. Sir Adam stated that a serious power crisis was in prospect, as by the end of next year every available horse-power of electric energy would be in use, even without the industrial boom which many were anticipating. Premier Ferguson definitely announced that if the Ottawa Government approved of the plans, the construction of the St. Lawrence power plant would be begun immediately. It is estimated that the development cannot be completed in less than four years, and in the meantime a serious power shortage may be experienced.

AMBULANCE RE-CONDITIONING WORKS OF THE METROPOLITAN ASYLUMS BOARD

(*For description see page 290*)

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ERECTING SHOP

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THE ENGINEER.

FEBRUARY 20, 1925.

Corrosion Again.

THE problems of corrosion are always with us, so much so that we begin to grow tired of discussing them and the theories built up around them. Yet there are probably few engineers who have not, from day to day, to face these same problems in the most practical way. This, when we consider the real nature of the materials of engineering, is not surprising. Our metals, with the exception of the "noble" metals, which hardly enter into engineering problems, are all extremely liable to oxidation and similar types of chemical action. To such an extent is this true that man has rarely found them in a state of nature except in an oxidised or other chemically combined condition, and it is only by the art of the metallurgist that they have been released from this chemical bondage and placed at the service of man. It is a consequence of this state of affairs that these same metals seek ever to return to their "natural" state, and the fight against corrosion is, essentially, a fight against this inherent tendency. In a few special cases we are able to obtain or to place the metals in a condition in which this tendency is more or less completely in abeyance. Some, like aluminium, spontaneously protect themselves by the formation of an impervious coating of oxide or similar compound, and so long as this protective coating is not removed by mechanical abrasion or severe chemical action or by a combination of both, corrosion cannot occur. Others, like chromium and some of its alloys with iron and other metals, appear to assume, under suitable conditions, that remarkable condition of chemical inactivity which chemists have named "passivity"; the true nature of which is not perhaps fully understood, although we are learning to utilise it, and have, as a result, rust-resisting steel and iron alloys.

While this universal tendency towards corrosion makes itself felt most obviously and in many instances unpleasantly, there are perhaps other cases where it is less clearly appreciated or even entirely overlooked. We are accustomed to expect, and as far as possible to guard against, corrosion in our structures exposed to the weather, or even to the action of sea water and sea spray. In the moving parts of machines, however, we rarely think of corrosion as an important factor. No doubt in the great majority of cases we are safe in disregarding it. Moving machinery is usually protected from the more violently corrosive agencies, such as water, chemical fumes, &c., and it frequently works at a temperature just high enough to keep it thoroughly dry, while it is often thickly coated with oil or grease. In these latter circumstances, provided that the oil or grease does not itself contain actively corrosive substances, the metal is protected very completely from attack, and it is only when the machinery stands still, when the oil may drain away or dry and harden, that moisture may gain access and start corrosion. There are, however, other moving parts whose lot is less sheltered, and in their case it is perhaps worth while considering whether a combination of motion, with more or less severe stresses often of an alternating nature, and corrosion, may not bring about deterioration far more rapid than would ordinarily be anticipated. It can scarcely be doubted that movement, and particularly friction, plays an important part not only in facilitating corrosion, but in affecting the manner in which metal is attacked. A very little observation serves to show that where steel or iron parts in contact have even a small amount of relative motion, a peculiar form of red iron oxide is produced. An excellent example is to be seen in the spring leaves of a motor car chassis, unless they are protected by being enclosed in a grease-filled envelope or "gaiter." Wherever two parts are fastened together and a very little rubbing occurs, as through the loosening of a bolt or rivet, this red oxide makes its appearance; in fact, the red colour is a clear indication that something is actually moving, where perhaps there should be no relative motion. In itself, this may not be serious, since, as has been well said, a very little iron makes a large amount of rust. On the other hand, it is quite possible that there may be consequences of an indirect kind which require consideration. Professor Haigh, some years ago, described experiments made with his fatigue-testing machine, in which he found that a test piece exposed to contact with slightly corrosive liquids failed much more rapidly than one which was clean and dry. It is not, however, only fatigue which may be accelerated by corrosion; there is a whole group of phenomena known as "season cracking," whose direct connection with corrosion is well known. Here there is, fortunately, a remedy which is easily applied, viz., the elimination of the internal stress which is the prime cause of failure, while corrosion is merely an accelerating factor. Nevertheless, it is important to realise that metal under stress, and more especially under tensile stress, is peculiarly liable to chemical attack. We do not know whether it has ever been noticed that the tension members of roofs and bridges are more liable to be attacked, perhaps in spite of protective coatings which are not quite impervious, than those parts working mainly under compression, but we should not be surprised to find that such is the case.

Unfortunately it is not possible, in the present state of our knowledge, to put forward any definitely satisfactory remedy for the incidence of corrosion on stressed parts. Engineers in practice meet these difficulties with such means as they can command—most frequently by the use of the paint brush. The fact, however, that corrosion tends actively to co-operate with stress towards the destruction or deterioration of metal is not widely known or recognised. Yet it is a matter calling for the careful consideration of practical engineers. It is not only a practical danger which has to be met, and, of course, is met in daily practice, but it is a valuable source of information. On the one hand, the occurrence of marked local corrosion can often serve as a useful guide to the presence of perhaps unsuspectedly heavy localised stresses, while, on the other hand, these considerations may suggest a possible remedy for the persistent tendency towards marked local corrosion which is a puzzling feature in many installations. This is a case where the daily observations of the practical man in charge can be of the greatest help, both to the designer who seeks to discover the real causes of trouble in his products, and to the investigator who, in order to find explanations and remedies, must first have all the facts at his disposal. His attention having been called to this point, it may be hoped that the practical man will place his observations on record or at least at the disposal of those more immediately interested. It is eminently a case where close co-operation is needed, and progress can best be achieved by the aid of the careful and intelligent observations of the practical man.

The New Wireless Bill.

A GOOD deal of criticism has been aroused by the Bill recently introduced in the House of Commons to re-enact and amend the law relating to wireless communication, for if passed it would give the Government large powers in the case of emergency, and a person who established or maintained a wireless

installation without a licence would be liable to heavy penalties. That the original Wireless Telegraph Acts of 1904 and 1906 need amendment, there can be no doubt. Wireless traffic, like other traffic, must be regulated, and owners of wireless apparatus, it seems, must be licensed like owners of motor cars. But judging from the letters that have appeared in the Press within the last few days, the provision in the new Bill which seeks to sanction, in certain circumstances, the search of a person's house for the detection of unlicensed apparatus, is distinctly unpopular. If there is reason to believe that an experimenter has set up transmitting apparatus without permission, the authorities are undoubtedly justified in searching the premises. Few, we think, will disagree that such persons ought to be severely dealt with, for apart altogether from the uses to which the installation may be put, in times of international unpleasantness, wireless communication cannot survive if everyone is to be allowed to transmit. But it seems that if the Bill be passed as it stands, anyone who installs a receiving apparatus without taking out a licence will also be liable to have his premises raided by the police. In that respect, the measure is scarcely in conformity with the usual form of British legislation, although we do not suppose for a moment that even if the Bill as it now stands became law, the drastic penalties which it contains would be enforced, save under exceptional circumstances. The belief that the existing Act contains nothing that can make the owner of a crystal set take out a licence has no doubt led many to evade paying the fee, but the prospect of quite a moderate fine would, in all probability, bring about a very great reduction in the number of unlicensed listeners and experimenters without the intervention of the police. Whilst the Post Office has been challenged by at least one crystal set owner to prosecute for the non-payment of the fee, no action has been taken, and that has, no doubt, led many others to evade payment.

We do not believe that penalties anything like as great as those which are now being proposed will be necessary to make the bulk of wireless enthusiasts pay for the services of the British Broadcasting Company. The sum demanded only works out at a little over 2d. per week. Even experimenters who are only interested in wireless from a scientific point of view, will, we think, readily admit that the British Broadcasting Company serves a very useful purpose. Those who were experimenters before broadcasting began realise this better than those who have taken up the work within recent times, for it often happened in the past that when a new circuit had been completed, many hours elapsed before it could be properly tested. Morse signals could, of course, be picked up during all hours of the day and night, but good telephony transmissions were extremely scarce. Now, however, the British Broadcasting stations provide the experimenter with all he needs to test his circuits. But, apart altogether from the question of enforcing the licence fee, the Government obviously has a right to exercise a certain amount of control over wireless experimenters. The crystal set user does not disturb the ether. Users of valves, on the other hand, very frequently do so, and if the new Bill sought to give the police power to enter the houses of people who make their sets oscillate, instead of the homes of those who do not take out a licence, it would probably prove more popular. Experience in America has shown how desirable it is to prevent a large number of people installing transmitting apparatus. Good research work has unquestionably been done, and is still being done, by amateurs. But some holders of transmitting licences, we venture to suggest, do little beyond amuse themselves by transmitting speech and music—often very inferior music—to their friends. What line of research some of these so-called experimenters are supposed to be engaged upon it is difficult to imagine, and we suggest that, in addition to exercising rigid control over the installation of additional transmitting apparatus, the Government should also look into the desirability of renewing some of the existing transmission licences. The activities of certain people who are allowed to use transmitting apparatus have often been referred to in the wireless Press, but with little effect on the offending parties. There are many persons, in our opinion, more qualified to use wireless transmitting apparatus than some who are at present permitted to do so.

The properly qualified wireless experimenter, and apparently the leading experts, are, it is reported, liable to be seriously interfered with by the new Bill, for it is feared that they may have to lay bare for official inspection all details of inventions they are working upon. We do not think that if there is any such suggestion in the Bill it will stand much chance of becoming law in its present form. Can it be imagined, for instance, that Mr. Marconi will have to lay full details of his proposals before a Government Department before he can proceed any further with his short-wave experiments, or that Dr. Fleming or anyone else will find it difficult under the new legislation to improve upon the valve? The science of wireless communication is far too important to stand undue interference from Government Departments. Professional men and properly qualified amateurs alike must be free to carry on their work, provided that it does not interfere with the legitimate purposes of radio communication as a whole. Only incompetent and mischievous persons should be subjected to Government control, and it is to be hoped that when the new Bill is put into force it will be quite free from all elements that would tend to hinder scientific progress.

Literature.

Regulation of Rivers Without Embankments. By F. A. LEETE, C.I.E., assisted by G. C. CHEYNE. London: Crosby Lockwood and Son. 30s. net.

THIS handsome and beautifully illustrated volume is a narrative of a series of events and a discussion of the conditions which led to the regulation of a number of streams at the head waters of the Rangoon River, and it includes detailed descriptions of the work done. The author is Chief Conservator of Forests in Burma, and Mr. Cheyne a Deputy Conservator. The main fact underlying the choice of methods for improving and controlling those streams is that a river carrying much silt in suspension may be induced to deposit it by the employment of a fence, with the pales spaced well apart, placed close to the river banks. A second fact, in this case of less importance, is that a submerged bund or dyke may also cause the deposit of silt. While submerged bunds and permeable dykes have been used to some extent, the author's description of the effects of low bunds and especially of a low bund parallel with the bank and some distance from it, points to results more definite and substantial than those usually attained by the adoption of this principle. As regards the spaced paling, this method, which is in principle the same as that of the permeable dykes which have been used, sometimes along-stream, to cause the deposit of silt, does not seem to have anywhere secured results so pronounced or so important as those attained in Burma, and described in this book. In England the principle has been followed at places on the coast in order to check the slow or slight erosion of beaches, and turn the balance in favour of deposition.

On the rivers with which Mr. Leete was concerned, bamboo fencing, consisting of stakes driven firmly into the ground about 9in. apart and 3ft. above ground, with a bamboo rail near the top, is the device adopted for inducing the river to build up its banks in the desired position. The natives had previously used close palings, which did not give such good results. The conditions determining the efficiency of this device are that the streams, flowing from hills of friable sandstone and shales, come to flat lands across which they flow in reduced channels. In these channels sand is deposited, the streams spilling over their banks and forming shallow pools in which thin layers of clay are deposited. In some cases the result is that the main channel dwindles till it is incapable of carrying the logs which the forest officers desire to convey by water to the coast. In some cases no main channel could be picked out, the stream dividing into many useless branches; and in one case a lake had been formed, through which it was difficult to float the logs without losing many through stranding and subsequent burial. The streams have been improved, partly by digging channels and sometimes building low bunds, but mainly by setting up the bamboo palings along the lines chosen for the positions of the banks. The author gives the credit for the first proposal to use bamboo palings to Mr. Weidemann, Assistant Commissioner of Irrawaddy, who, in 1877, suggested the use of close palings, such as the natives used to cause local deposits, the open palings being a recent development.

Mr. Leete and Mr. Cheyne are to be congratulated on the successful presentment in this volume of the problem and its solution, the measures taken having resulted in the salving of thousands of teak logs, the establishment of satisfactory water routes for the timber felled annually, and the improvement of the lands alongside the streams. As regards the scope of the methods followed, it may be suggested that they have some application as regards a few places here and there on very many rivers, that they have a supplementary application to a considerable number of rivers on which the main works have a different character, and that they have an important field of usefulness in the cases of streams like the headwaters of the Rangoon River. The author himself writes: "Regulation of rivers without embankments does deserve to rank as one permanent method of control along with regulation with embankments." He adds: "Control without embankments cannot be effective with all kinds of rivers. It is only applicable to streams which start as hill torrents heavily charged with sandy silt."

While the book deals usefully with topography, causes of deterioration in the streams, logging operations, and channel obstruction, engineers will especially study two chapters, Chapter VI., in which the regulation of the Myitmaka is described, and Chapter VII., which takes training works without bunds as its subject.

The author has no great skill in the arrangement of his matter, and the reader will do well to get a clear idea of the history of the operations, as well as the characters of the streams, before beginning a second and closer reading of the book, with a view to obtaining the benefit of the well-expressed statements relating to more strictly engineering matters. There are ten maps in the volume, nine useful diagrams, and thirty-six reproductions of photographs, the last-named deserving high praise. Many of them show so much detail that they supplement the text in a valuable manner. Apart from its interest to forest officers and engineers who are concerned with river control works, this book should on no account be missed by irrigation engineers, and it deserves mention also as a library book dealing with Burma.

The J.P. Transformer Book. By S. AUSTEN STIGANT and MORGAN LACEY. London: Johnson and Phillips, Limited, Charlton. Price 5s.

IT is unusual for a manufacturing firm to publish a technical book. Technical men connected with engineering firms frequently write books, which are presented to the public by one of the well-known publishers; but so far as we are aware, this is the first occasion on which a truly technical volume of interest to designers and others has been published by a manufacturing concern.

The authors both belong to the transformer department of Johnson and Phillips, Limited, and they are both well versed in transformer design and construction, and in the past they have written a good deal that is of value to transformer users. As many electrical engineers are well aware, Johnson and Phillips issued some time ago a series of pamphlets called "Transformer Abstracts." These pamphlets, which were supplied to the electrical profession free of charge, were by no means advertising pamphlets in the ordinary sense, for they were devoted to transformer problems that arise in everyday electrical work, and we believe that they were very much appreciated.

All the information contained in these pamphlets has been embodied in this new book, as well as additional information relating to design, construction and operation. This has resulted in the production of a volume of 400 pages, which conforms in all respects with the transformer users' requirements. Although the static transformer is quite a simple and straightforward piece of apparatus, its practical application under different conditions presents a good many problems. There are many ways, for instance, of connecting transformers to polyphase circuits, and it is not always a simple matter to choose the most suitable arrangement. A chapter has therefore been devoted to this branch of the subject.

In the main double-wound transformers are considered, for in practice such transformers are most commonly employed, but single-wound or auto-transformers are also taken into account. From the user's point of view this chapter on transformer connections is undoubtedly one of the most useful in the book, although there are others of considerable value to operating engineers, such as a chapter on the causes of transformer failures. Parts of the volume may, however, prove a little too technical for the average power station man, who has many other things to study besides transformers. A chapter at the end of the book on the influence of transformer connections upon the third harmonic pressures and currents, for instance, contains some rather complicated diagrams which are likely to prove a little puzzling to men who are not transformer specialists.

A chapter on transient phenomena occurring in transformers is another which is of no small value to practical engineers. Other chapters deal with fundamental transformer principles, transformer inquiries and tenders, transformer and oil specifications, general types and characteristics, final factory and test runs, dispatch, installation and maintenance of oil-immersed self-cooled transformers, parallel operation, neutral point earthing, transformer protection, effects of sustained operating conditions, static balancers and transformer oil. There is also an appendix dealing with the B.E.S.A. Specification No. 148 of 1923.

Some good books on transformers have been written in the past, but many of them, we fear, are now out of date. Moreover, most writers on the subject have confined themselves mainly to design and have somewhat neglected the equally important subject of operation. In the present volume, however

the operating engineer will find all the information he requires, and there is not much doubt, we think, that the volume will have a very wide circulation.

Electrical Technology. By H. COTTON, M.Sc. London: Sir Isaac Pitman and Sons, Limited. Price 12s. 6d.

THIS is a text-book covering the syllabus of the B.Sc. (Eng.), Associate Membership of the Institution of Electrical Engineers, and the National Certificate examinations in electrical technology. It is a far more practical volume than many that have been written for the use of students, and as the author suggests, it may also appeal to practical engineers. It is not a book we should recommend to beginners, for the most elementary portions of the subject have been omitted; but those who have already mastered the first principles of electrical engineering and are embarking upon the more advanced work will find the volume a decided help. For the most part, the author confines himself to direct-current and alternating machinery, *i.e.*, dynamos, motors and alternators and converters, although there are also chapters on illumination, electrolysis, transformers, phase advancing, electric furnaces, electrical measuring instruments, &c.

Students and others who are interested in wireless matters are catered for in another chapter on electrical oscillations, where the author deals with electromagnetic waves, oscillatory circuits, the generation of oscillations by means of the triode, rectification and other matters relating to this fascinating branch of electrical science. On the whole, the author has covered the field of electrical engineering about as well as it is possible to do so in a book of less than 400 pages.

It is by no means an easy task in these days to deal with electrical engineering, or even with all the most important branches, within a single book, but Mr. Cotton has managed to go a considerable way in that direction, and has produced a volume that should prove a good introduction to many other books which are devoted exclusively to different branches of the subject. Of course, some of the sections have of necessity been made very brief. Electric welding, for example, is given just over two pages, and electric furnaces a little over six. The book is well up to date, but in one or two places the author has devoted space to things that are only occasionally met with. The split-pole rotary converter, for instance, is not at all a common form of machine, although it is perhaps just as well that the student should be made familiar with it.

In view of the fact that the neutralised series single-phase motor has now ousted all other types of single-phase motors for traction work, the author should, we think, have paid more attention to that type of machine, and less to the repulsion motor.

All the orthodox methods of starting rotary converters are described, but no mention is made of the fact that the latest practice is to make rotary converters start up on their own accord. We have no fault to find, however, with the author for not endeavouring to describe a fully automatic sub-station. On the other hand, he might, we think, have given a rough description of an automatic mercury vapour plant, which is less complicated. There is no doubt, in our opinion, that mercury vapour rectifiers and possibly other forms of rectifiers are going to play an important part in electrical engineering, and writers of technical books should keep that fact in view. Mr. Cotton does not, we suggest, pay sufficient attention to the mercury vapour rectifier. Nor do we think that he has adequately considered the use of the static condenser as a means of improving the power factor.

On the whole, however, the volume meets the requirements of students who have studied the first principles of electrical engineering. It contains a good many examination questions and answers, which should prove helpful to students and young engineers.

SHORT NOTICES.

Concrete-making Machinery: Including Appliances and Plant for Testing and Preparing the Constituent Materials and for the Distribution of Mixed Concrete. By W. Noble Twelvetrees. London: Scott, Greenwood and Son, 1925. Price 8s. 6d.—This is Vol. XXXV. of the Broadway Engineering Handbooks, and it is divided into seven chapters, the titles of which are:—"Concrete and Its Constituents," "Preparation of Materials for Concrete," "Typical Sand and Aggregate Plants," "Concrete Mixing," "Concrete Mixing and Distributing Machinery," "Gravity Distribution Plant and Cableways," and "Design of Concreting Plants"—a list which sufficiently indicates the scope of the work. A great deal of ground is covered in a comparatively small space—some 180 octavo pages—and the descriptive text is clear and succinctly written. Practically all the leading concrete-mixing machines come in for notice. The book is profusely illustrated, but whereas the line drawings are for the most part excellent, many of the half-tone engravings are distinctly poor, blocks from makers' catalogues—and worn blocks at that—having evidently been used in many cases.

Outlines of the Occurrence and Geology of Petroleum. By I. A. Stigand. London: Charles Griffin and Co., Limited. Price 10s. 6d. net.—This small volume, described as an introductory handbook, should prove of great value to students of oil geology and also to those concerned with the economic or commercial aspects of oil. Following an introductory chapter, in which an explanation is given of the principal terms employed in the science and industry of petroleum recovery, the author devotes considerable space to a discussion of the different theories regarding the origin of mineral oil and its associated substances. Incidentally, he inclines, we observe, to favour an organic origin, although he regards it as futile to confine belief to one universal mode of formation. He then reviews the stratigraphical distribution of petroleum, its accumulation, concentration and movement, and, finally, discusses the general features of petroliferous strata and the direct indications of petroleum to be looked for in prospecting. A very useful appendix is contributed by Dr. Max Mühlberg on the important new studies now being prosecuted in connection with the finding of oil by geophysical methods.

Reinforced Concrete Beams in Bending and Shear. By Oscar Faber. London: Concrete Publications, Limited, 4, Catherine-street, W.C. 2. Price 9s. net—This volume may be regarded as an extension of the work entitled "Reinforced Concrete Design," written a few years ago by Dr. Faber and Mr. P. G. Bowie. It deals with the verification of the resistance of reinforced concrete beams, both with and without compression reinforcement, and discusses the relative value of two methods of calculating the resistance of doubly reinforced beams. It also gives a new treatment of shear in concrete beams, and describes the experimental researches on which the rules and formulæ of that treatment are based. This third part of the work is really its principal section. Having briefly reviewed the ordinary theory of shear in reinforced concrete beams, Dr. Faber proceeds to describe his own theory. The results of tests are then quoted, and are held to show that the new formulæ have a far closer experimental justification than have the R.I.B.A. or the new L.C.C. rules.

Home Sewage Disposal. By W. A. Hardenbergh. London: The J. B. Lippincott Company. Price 16s. net.—The author of this book, among his other qualifications to write on the subject, is the Sanitary Engineer and Director of Rural Sanitation to the Jefferson County Board of Health, Alabama, and that he worthily fills that position is amply evident by the work under consideration. Though it is written to deal mainly with conditions as they exist on the other side of the Atlantic, the volume, in practically all its subdivisions, is applicable to outlying and unsewered districts in this country, and it would be well if much that it contains were more widely known, particularly those portions which deal with the fly menace and the proper construction of privies. It is a clearly written and excellently illustrated detailed treatise on a very important subject, and we have perused it with considerable interest.

Gas Meters. By A. T. Gilbert. London: Crosby Lockwood and Son. 1925. 7s. net.—An eminently practical book describing the construction and operation of all kinds of gas meters, and also explaining their relative merits for various services. Instructions are given for the repair and maintenance of meters and for their testing, both *in situ* and at the special testing station. A considerable amount of space is devoted to prepayment meters, a subject on which there is very little literature in existence. The book should prove useful to all concerned with the installation of gas meters, and might will be read by people who are only interested in meters as consumers of gas.

BOOKS RECEIVED.

Antimony Ores. By E. Halse. London: John Murray, Albemarle-street, W. 1. Price 5s. net.

Bismuth Ores. By R. Allen. London: John Murray, Albemarle-street, W. 1. Price 3s. 6d. net.

Hydromechanik. By M. Samter. Charlottenburg: Robert Kiepert, Hardenbergstr., 4 u 5. Price 3.20 marks.

Distillation Principles. By C. Elliott. London: Ernest Benn, Limited, 8, Bouverie-street, E.C. 4. Price 6s. net.

Engineering Mathematics. By R. W. M. Gibbs. London: Blackie and Son, Limited, 50, Old Bailey, E.C. Price 4s. net

The Slide Rule. By A. Williams Price. Birmingham: Cornish Brothers, Limited, 39, New-street. Price 3s. 6d. net.

Acid Resisting Metals. By S. J. Tungay. London: Ernest Benn, Limited, 8, Bouverie-street, E.C. 4. Price 6s. net.

The Dust Hazard in Industry. By W. E. Gibbs. London: Ernest Benn, Limited, 8, Bouverie-street, E.C. 4. Price 6s. net.

Conformal Representation. By Leo Lewent. London: Methuen and Co., Limited, 36, Essex-street, W.C. 2. Price 7s. 6d. net.

Mechanical Mixing Machinery. By L. Carpenter. London: Ernest Benn, Limited, 8, Bouverie-street, E.C. 4. Price 6s. net.

Die Kondensation bie Dampfkraftmaschinen. By K. Hoefer. Berlin: Julius Springer, Linkstr. 23-24. Price 22.50 gold marks.

Boiler Feed Water. By N. Simpkin and A. Dawe. London: H. F. and G. Witherby, 326, High Holborn, W.C. Price 2s. 6d. net.

Verzeichnis der Dr.-Ing.-Dissertationen. By W. B. Niemann. Charlottenburg: Robert Kiepert, Hardenbergstr. 4. Price 6 marks.

Agitating, Stirring and Kneading Machinery. By H. Seymour. London: Ernest Benn, Limited, 8, Bouverie-street, E.C. 4. Price 6s. net.

Les Notions Fondamentales a Elément Chimique et D'Atome. By G. Urbain. Paris: Gauthier-Villars et Cie., 55, Quai des Grands Augustins. Price 10f. net.

The Involute and Barrel Types of Stator Winding for A.C. Electric Generators. By R. Smallwood. London: The Association of Engineering and Shipbuilding Draughtsmen, 96, St. George's-square, S.W. 1. Price 2s. net.

SIXTY YEARS AGO.

IN view of the considerable amount of professional and public attention now being paid to the condition of certain of the bridges which span the Thames, some information of a topical nature may be found in an article dealing with the use of iron caissons for foundations which appeared in our issue of February 17th, 1865. It was recorded that the piers for the old bridge at Westminster, then recently replaced by the existing structure, were formed on a plan which, though expensive, caused continual trouble throughout the whole life of the bridge. The piers, it seems, were built by lowering the bottom courses of masonry encased in wooden caissons into holes dredged out to the gravel bed. The sides of the caissons were carried up above high water level in order that the caissons might be pumped dry and the masonry continued to a convenient height. The wooden sides were then removed. Twelve years were spent on the construction work, but the scour of the river on the gravel strata on which the whole weight of the foundations rested gave trouble almost from the first. For the new Westminster Bridge the spaces on which the piers were to be built were enclosed with iron sheet piling. Elm piles 16in. square were then driven over the enclosed area with a 2-ton monkey. The mud and gravel between the piles were dredged out down to the clay, and concrete was filled in round the piles to within about 3ft. of the top of the iron sheet piling. On the surface of this concrete the first course of masonry was laid. We characterised this plan as ingenious but tedious and uneconomical. The bridge was tested a few months ago by Messrs. Rendel, Palmer and Tritton, and in their report, published this week, it is stated that the foundations are still good for much more than a hundred years. Dealing with Waterloo Bridge, we stated that the construction of its foundations presented the first use on the Thames of a system of forming cofferdams consisting of several rows of piles with puddled clay filling up the spaces between them. The dams for Waterloo Bridge consisted of three rows of piles 3ft. 6in. apart. Over the enclosed surface beech piles were driven well into the clay. On these piles cross sills and level floors of 6in. planking were fixed to carry the masonry. The piers of London Bridge were constructed in a similar manner. The system, we remarked, was costly and lengthy, but its efficiency was proved by the stability of the foundations. During the past week the foundations of Waterloo Bridge have been described as "worn out." The article also gave details of the foundation systems used for the Charing Cross, Blackfriars and other Thames bridges and for the Thames Embankment.

DIESEL ENGINE USERS' ASSOCIATION.

AT the meeting of the Diesel Engine Users' Association held on Friday last, Mr. P. A. Holliday gave a paper on "Submarine Engines and High-speed Heavy Oil Engine Electric Generating Sets." In it the author referred to the rapid development of the high-speed oil engine, which the war demand for submarine engines brought about. He particularly dealt with the utilisation of ex submarine engines of the M.A.N. type for work in power stations. Interesting particulars were given by Mr. Holliday as to the modifications made in converting the engines for use on land. The engines so converted had, the author said, demonstrated the practicability of employing quick-running oil engines for power station work, and the results obtained were of interest to users on account of the lower fuel costs of these engines and the smaller overall dimensions compared with standard land engines of the slow speed type. The latter part of the paper described the installation of several German ex-submarine engines at the Corporation electricity works, Southend-on-Sea. At this station ten ex submarine engines are installed in the main power-house and in two sub-stations, the complete plant representing a total generating capacity of 5000 kilowatts. The engines were converted and reconditioned by Belliss and Morcom, Limited, of Birmingham. At the main power station in London-road, two 500-kilowatt and one 780-kilowatt units operate in conjunction with steam plant. An exhaust gas boiler is fitted to each engine, and is designed to work at a pressure of 160 lb. per square inch. The steam so generated is fed into the ring main of the main coal and oil fired boilers. The exhaust gas boilers also form, we learn, very effective silencers, and are placed close up to the engines, so that heat losses are reduced to a minimum. In preparing this paper, Mr. Holliday has rendered a service to oil engine designers by putting on record some of the details of the engines which were used in the enemy submarines, which are enhanced by a very complete set of detailed drawings that accompany the paper. In the discussion which followed, reference was made to the early work, on high-speed oil engines for naval use, done by British oil engine builders, and later developments in connection with high-power submarine engines were touched upon. The opinion was expressed that high-speed engines would not be cheaper to build than standard slow-speed engines. In his paper the author referred to the use of a submarine type of engine on the Lomonossoff-Diesel electric locomotive, and in the discussion the suggestion was put forward that British builders would do well to study the design of high-speed oil engines for such work. Such a development, if successful, would certainly find a reflection in future power station practice.

AT the annual meeting of the Association of Professional Engineers, held in Toronto, the reports presented indicated substantial progress since its formation in 1922 under an Act of the Ontario Legislature. The membership now numbers 1118. A resolution was adopted instructing the Council of the Association to take steps to have the term "engineer," when used in its professional sense in Acts of the Legislature defined as meaning a "registered professional engineer." Professor H. E. T. Haultain, of Toronto, was elected president.

A New Type of Hydraulic Turbine.

SOME interesting hydraulic turbines of a new type have recently been successfully put to work in a hydro-electric power station at Wynau, in Switzerland. The noteworthy features of these machines are :—(1) The helical shape of the runners ; (2) the comparatively high speed at which they work ; (3) the high maximum efficiency ; and (4) the comparatively high efficiency at lower heads than the maximum which are attained.

Prior to the installation of these turbines there was already in existence at Wynau a power-house which was supplied with water by a barrage across the river Aar. More power being required, it was decided to construct a further power-house at the other end of the barrage, that is to say, on the opposite bank of the river. The turbines in the original power-house are of 860 horse-power, and they run at only 42 revolutions per minute. It is therefore necessary to drive the alternators through bevel gearing, so as to obtain a reasonable speed, and for the new installation it was desired to dispense with gearing and to drive the alternators direct.

It happened that for some time previously Les Ateliers de Constructions Mécaniques de Vevey had been experimenting with high-speed turbines fitted with "propeller" runners or "roues à hélice," and had obtained some remerkable results, though the diameter of the rotors employed was only 380 mm., or just under 15in. It sounds a rather brave thing to do, but the authorities of the Wynau power-house, on the data afforded by one of these experimental machines, decided to order two "propeller" turbines, each capable of developing a maximum of 2700 horse-power when running at a speed of 107 revolutions per minute under a maximum head of 5.2 m., or, say, 17ft. Their confidence was, however, justified, for the guarantees of the makers were comfortably exceeded, and it is a fact worthy of note that the maximum efficiency with full head of water coincided very closely indeed with full load, which indicates how accurately the data obtained with the small rotor had enabled the makers to calculate the dimensions and form of the very much larger machines. Although the turbines had to work under a maximum head of 5.2 m. they had also to operate satisfactorily with as low a head as 2.4 m., or, say, 7ft. 10¼in.

The Vevey firm by no means claims to be the first to introduce this form of runner. Indeed, it draws attention to the fact that the old Jonval turbine had runners of that type, and freely acknowledges that it has, in carrying out its investigations, made full use of the discoveries of Truax in 1860, of Horton in 1877, of Williams in 1893, and of Nagler, of Milwaukee, and of Dr. Kaplan, of Brunn, more recently. What it does claim to have done is, by embodying all the good points of others and by making certain modifications and improvements as the result of its own studies, to have produced a moderately high speed turbine which, while having a high efficiency at or about full load, still has an excellent efficiency at lower loads, while its efficiency remains high throughout an extraordinarily wide range of head.

The types of runner and casing which it evolved as the result of its investigations, are shown in Fig. 1, while

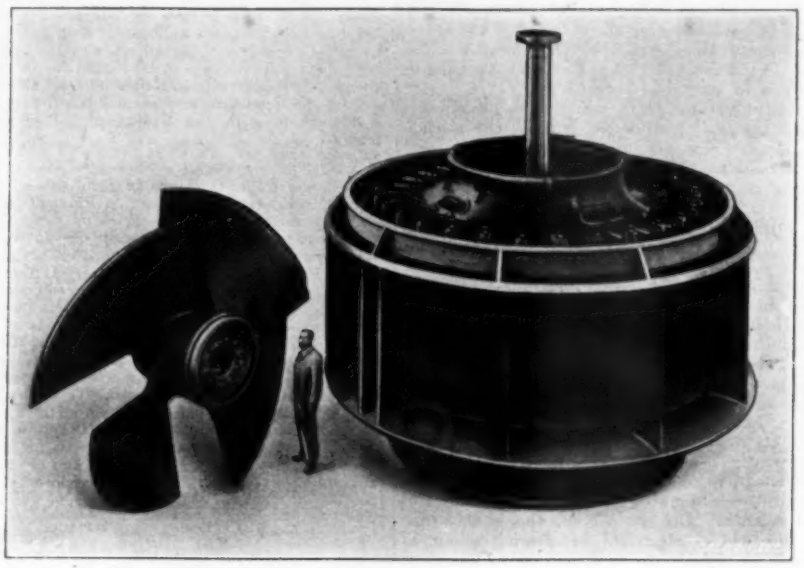


FIG. 1—HELICAL TURBINE RUNNER AND CASING

drawings of the installation at Wynau are given in Fig. 2. The makers prefer not to disclose any detailed dimensions, but informs us that the scale of the original drawing from which Fig. 2 has been reduced, is 1 to 30, and from that we deduce that the diameter of the largest circle traced out by the tips of the propeller blades is about 11ft. 4in. The water is led to the distributor through a

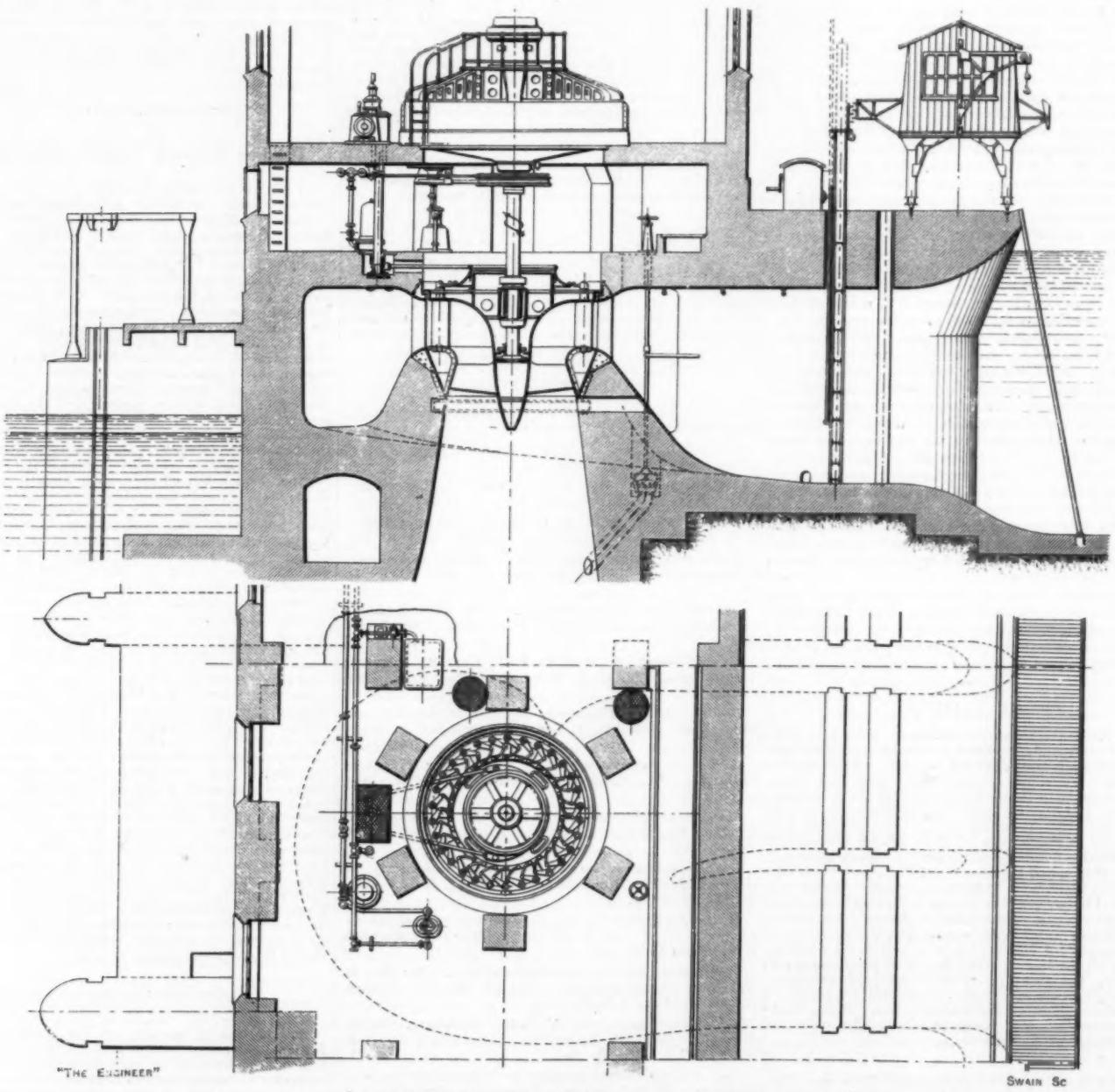


FIG. 2—SECTIONS THROUGH TURBINE HOUSE AT WYNAU

spiral concrete flume, which is shaped symmetrically so as, by the elimination of eddies, to simplify the gauging of the flow. The form given to the discharge flume was worked out with great care, because of the considerable velocity of the water as it leaves the runner, which may correspond to a quarter or even to one-third of the total energy. The drowned discharged flume permits of a large proportion of this residual energy being recovered because of the gradual transformation of the velocity into vacuum or suction below the runner. The latter,

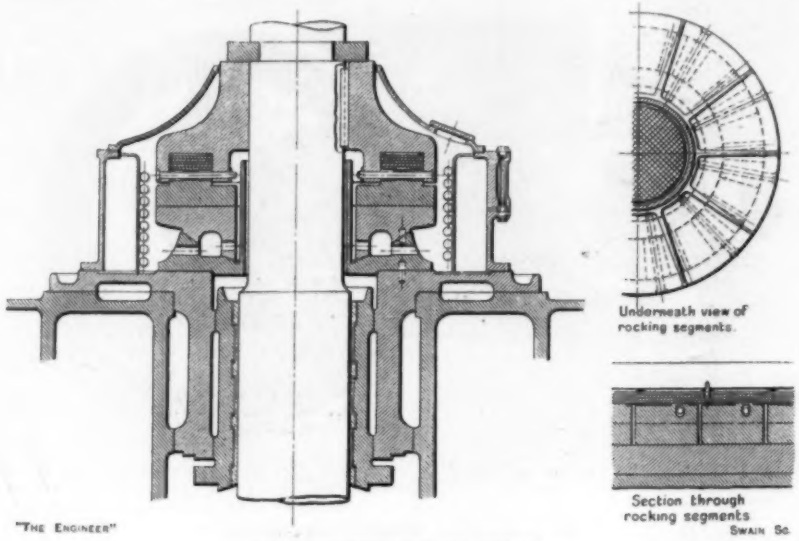


FIG. 3—ARRANGEMENT OF BEARING

which is of steel cast in one piece with blades and boss, was supplied by Les Aciéries Fischer, of Shaffhousen. It has four blades with no peripheral ring joining the tips together, and it is not at all unlike a ship's propeller. With a view to reducing the velocity remaining in the water after passing the runner, the diameter of the latter, or rather the diameter of the circle swept by the tips of its blades, is made larger at the exit than at the inlet. The blades are made relatively long to render the passage of

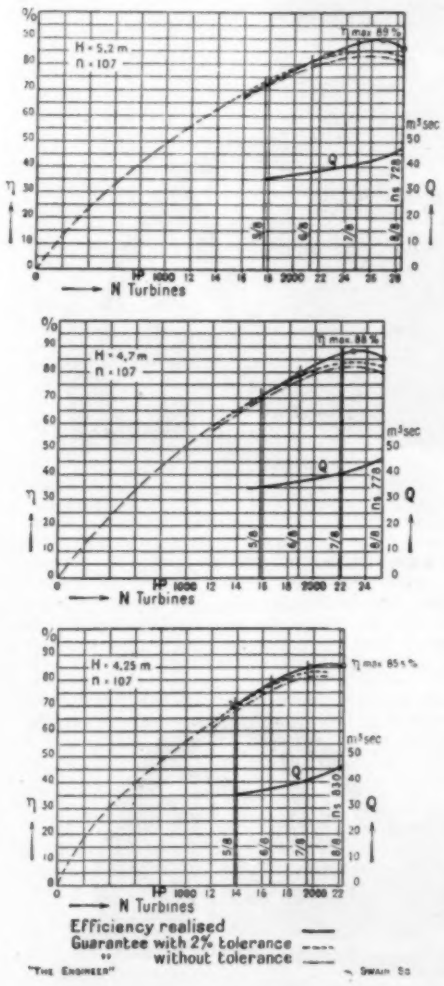


FIG. 4

the water as easy as possible and to avoid objectionable eddies.

The general construction of the turbine is evident from the half-tone engraving and does not call for much comment. It is, in several respects, similar to the ordinary vertical-spindle axial flow Francis turbine. It is furnished with thirty adjustable guide vanes, which are hydraulically controlled in the ordinary manner by oil under a pressure of some 220 lb. per square inch, which is furnished by a pump driven through double reduction gearing. Each turbine has two distinct safety devices, one of which comes into operation should the governor cease to work owing to its belt breaking or coming off or to its sticking, while the other is brought into action should the speed, which, it will be remembered, is normally 107 revolutions per minute, exceed 120 revolutions per minute. In both cases the supply of water is cut off from the runner by the closing of the control vanes.

The main bearing, which is mounted on the spider above the alternator, not only supports the weight of the revolving portions of the turbine and alternator, but also takes the thrust of the water on the turbine runner. The total load may reach as much as 82 tons. The bearing, which we understand has been fully patented by the Vevey firm, is shown in Fig. 3. The journal has a diameter of 940 mm.—just over 33in. It is furnished with rocking segments, which rest and can, within limits, move about on a thin film of oil that is admitted between them and the journal. These segments are carried on flexible rings of hard or nickel-chrome steel, by means of which a uniform distribution of the load over all the segments and over the whole width of the latter is assured, even, so it is claimed, when the mounting, or even the work itself, is not rigorously exact.

The makers inform us that, on coming to test these turbines when in position, it was found that their starting torque was high and their steadiness in working good. In the trials of the small experimental runner, which was tested under a head of water nearly as great as that at Wynau, it was observed that, when keeping the head and speed constant, the flow of water, the power developed and to a certain extent the efficiency were reduced somewhat—perhaps to the extent of 3 per cent.—after the machine was put to work. The large turbines have not displayed a similar defect.

The official tests were carried out with great care and precision. The power was measured under the direction of the Swiss Bureau Hydrométrique du Service Fédérel des Eaux, while the electrical measurements were made under the supervision of the Station d'essai et d'étalonnage de l'Association Suisse des Electriciens. The results obtained are set out in the diagrams given in Figs. 4 and 5. It will be observed that in Fig. 4 are given the results obtained with three different heads, 5.2 m., 4.7 m., and 4.25 m. respectively. The maximum efficiency reached with a head of 5.2 m. was 89 per cent., which corresponds to a specific speed of 728 revolutions per minute.* It will be seen, too, that with a head of only 4.25 m., an efficiency of 85.5 per cent. was observed. We understand that with heads varying as much as from 2.5 m. to 5.2 m., the difference in efficiency does not exceed about 8 per cent.

To enable our readers who are unaccustomed to diagrams of the kind to understand that reproduced in Fig. 5, let us take a specific example. With a head of 5 m. the efficiency corresponding to full load, 2730 horse-power—which may be observed by taking the intersection of the line "full capacity" with the ordinate 5 m.—is as will be seen, 86 per cent., while at $\frac{7}{8}$ full capacity it is 87.7.

The makers make the following claims for turbines of this type :—

(1) That they are specially suitable for employing, at minimum expense, the waters of rivers in more or less flat country in which there is a high discharge but a small fall ;

(2) That they run at a fairly high speed so that the size of the alternator and of the buildings containing the machinery may be reduced as compared with those required for slower running turbines ;

(3) That their efficiency between three-quarter and full load is high, while that of the alternators is higher also because of the increased angular velocity ;

(4) That as the power obtainable falls off less with reduced falls than does that of a Francis type turbine, the *turbine à hélice* is particularly suited for varying heads of water ;

(5) That the runner having only a small number of blades, the distance between them can be made at least three times greater than is possible with a Francis type turbine which minimises the chance of trouble from obstacles getting between the blades. Furthermore, it is possible, for the same reason, to increase the distance apart of the bars of the protecting grid, thus realising (*a*) a reduction in first cost of the grids ; (*b*) a reduction in the loss of head brought about by the grids ; and (*c*) a reduction in the cost of keeping the grids clear ;

(6) That the electric machinery, owing to its higher speed, is lighter for the same output, so that it is possible to use cranes of smaller lifting capacity, and building walls of less thickness ; and

(7) That the runner, since it has but a few blades which are cast in one piece with the boss, is more robust than a Francis type runner.

We are informed that, so satisfied were the proprietors of the Wynau power station with the operation of these machines, that they ordered from the Vevey firm two additional units of precisely the same character.

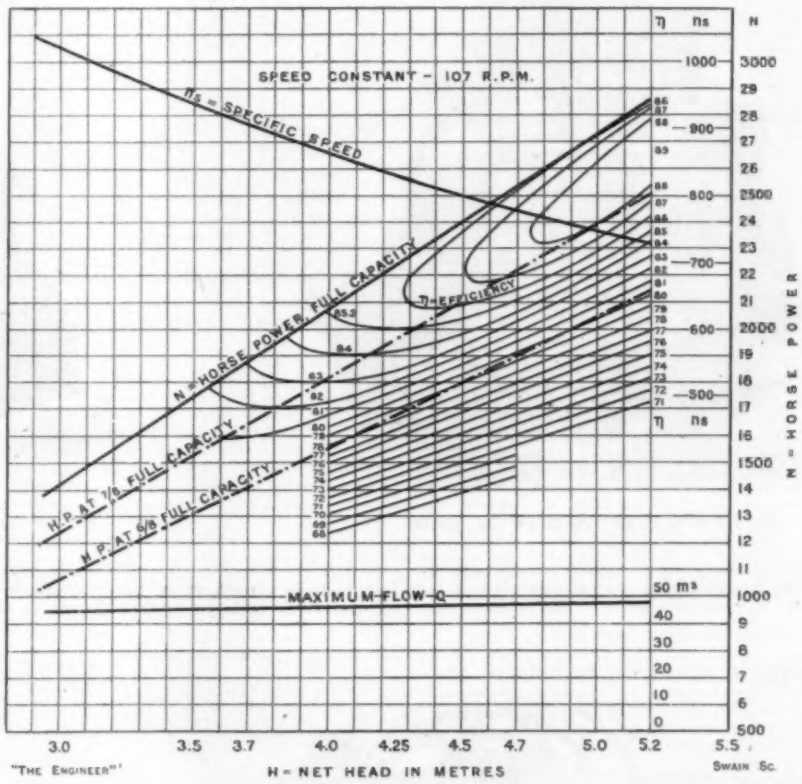


FIG. 5

WE are informed that Sir Thomas H. Holland, K.C.S.I., K.C.I.E., F.R.S., has been elected president and the Right Hon. Viscount Cowdray of Cowdray, G.C.V.O., Sir John Cargill, Bart., Mr. Alfred C. Adams, Mr. Alexander Duckham, F.C.S., Mr. Arthur W. Eastlake, M.I. Min. E., A.M.I. Mech. E., and Mr. Robert Redwood, F.C.S., have been elected vice-presidents of the Institution of Petroleum Technologists for the ensuing year.

* The specific speed of a turbine is the speed at which it would run if it were reduced to such a size as to develop 1 horse-power under a head of 1 metre.

The British Industries Fair.

No. I.

ON Friday, February 13th, the British Industries Fair was opened for a Press inspection, but it was little more than an untidy mass of building materials. The Exhibition authorities were, however, so energetic over the week-end that on Monday there was hardly a single stand incomplete. And this was all the more remarkable in that this year the London and Birmingham sections have been joined together, so that there was about double the usual amount of work to get through. The combined show is being held in the three aerodrome buildings at Castle Bromwich, near Birmingham, and remains open until Friday, the 27th.

The inclusion of the London display, generally held at the White City, has, of course, resulted in the Exhibition at Castle Bromwich of a lot of light fancy goods of little technical interest; but the arrangement of the Fair is such that different classes of manufactures are grouped together as much as is possible, and the visitor need not waste his time in searching, for instance, for engineering tools among the stands displaying toys and bird-cages. The engineering section, which is concentrated in the centre building, is considerably more interesting than it was last year, and although several firms, which we have been in the habit of expecting at the Fair in the past, have dropped out, others have taken their places, and, with the exception of machine tools, the show is quite representative of the Midland engineering industry.

It is noteworthy that there is an unusually large number of gas and oil engines shown at work, and among them three by Crossley Brothers, Limited, of Openshaw, were conspicuous through being the first to get under way. One of them—that illustrated in Fig. 1—had not been run up, on the occasion of our visit, since it left the shops a couple of weeks ago. It was, nevertheless, started with very little difficulty, and no special preparation. The engine shown is working on town gas, but can be altered by the addition of a carburetter for running on paraffin. As will be seen from the illustration, all those parts such as the magneto, governor and valve gear, which may need attention while the engine is running, are kept well clear of the fly-wheels, so that the driver runs no risk of injury in making any adjustments. The governing is effected by varying the stroke of the admission valve, by means of changing the position of the fulcrum of its rocking lever. This fulcrum takes the shape of a finger terminating in a knife edge, which is arranged between the two cheeks on the valve casing. The finger is rocked, about the pivot at the top, by the governor, and the knife edge moves along the curved upper face of the rocking lever, so as to regulate the opening of the admission valve according to the load on the engine. The admission valve is in a separate casing, so that it can easily be removed for examination or cleaning, and when this casing has been taken off the exhaust valve can be withdrawn through the same opening. These engines are made in several sizes, from 5 up to 19 horse-power. That exhibited is of 12¼ brake horse-power, and runs at 500 revolutions per minute.

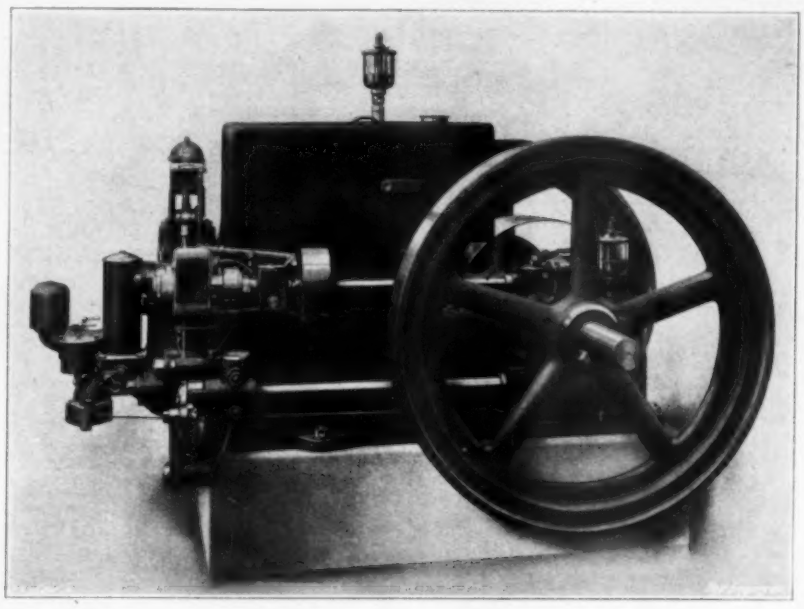


FIG. 1—12¼ B.H.P CROSSLEY GAS ENGINE

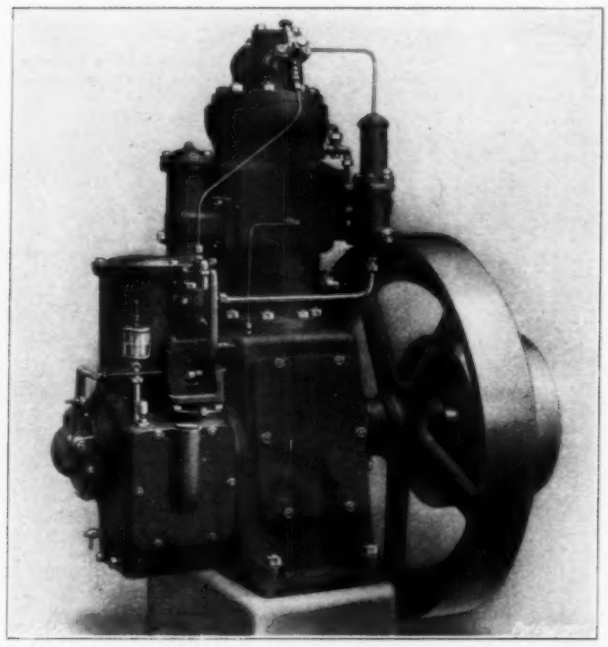


FIG. 2—14 B.H.P. CROSSLEY OIL ENGINE

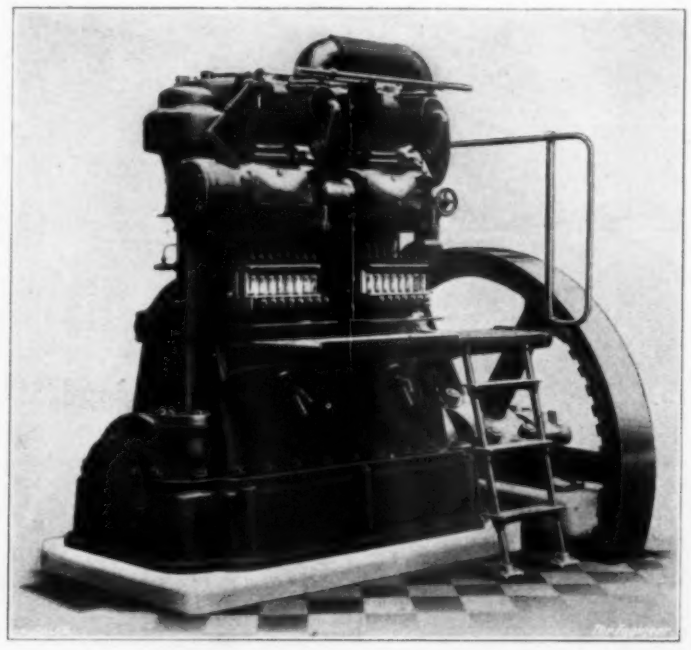


FIG. 3—110 B.H.P. RUSTON OIL ENGINE

The vertical engine illustrated in Fig. 2 is a new type of two-stroke crude oil engine by the same makers. The characteristic feature about this engine is the use of a separate pump for supplying the scavenging air, which consequently relieves the crank case from doing duty as a compressor and minimises difficulties in lubricating the main bearings,

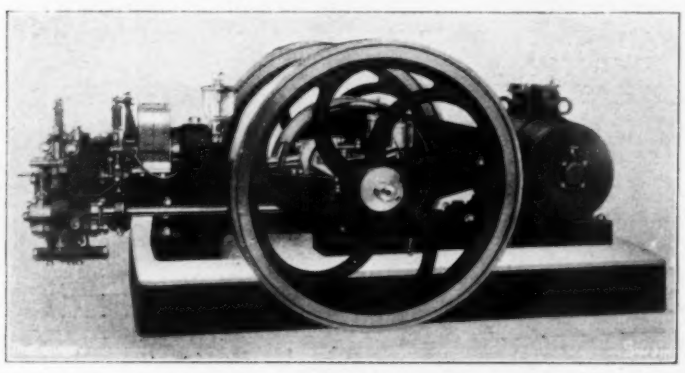


FIG. 4—3½-KILOWATT NATIONAL LIGHTING SET

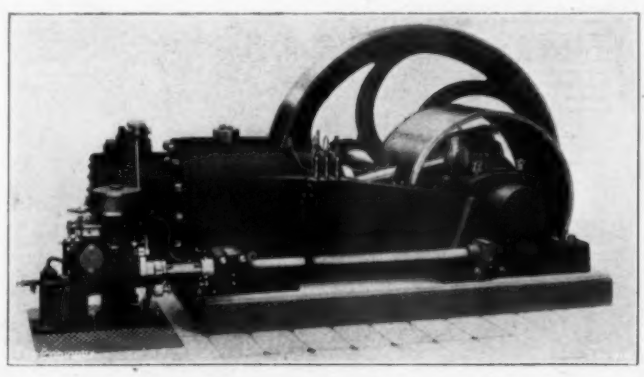


FIG. 5—66 B.H.P. NATIONAL OIL ENGINE

The pump can be seen, on the side of the main casing, in Fig. 2, and has a positively operated admission valve. It thus prevents any liability to "four-stroking" or missing. The main bearings and other running parts are lubricated by a forced-feed system. The engine shown is of 14 brake horse-power, and the makers state that its fuel consumption is about half a pint of oil per brake horse-power per hour. On the same stand there is also a 31 horse-power horizontal, cold-starting oil engine, the general design of which is familiar to our readers.

The National Gas Engine Company, of Ashton-under-Lyne, have several engines running, among which there are a little lighting and a heavy oil engine, which are illustrated in Figs. 4 and 5.

The lighting set comprises a gas engine and a dynamo driven by means of a chain. The combination has the advantage that the engine can be run at a comparatively low speed, which is naturally best for long continuous running, while the size of the dynamo can be kept within reasonable limits as to dimensions, and is correspondingly reduced in price. The chain is of the silent, toothed type, and runs in a totally enclosed cast iron oil bath. The gear ratio is about 3¼ to 1. In the case of the engine exhibited, which has an output of 3¼ kilowatts, the chain sprocket is arranged inside one of the fly-wheels; but with larger sizes, when there is only one fly-wheel, an outboard bearing is provided and then the sprocket wheel is placed outside the fly-wheel. The engine itself is of the National Company's normal design, and needs no extensive description. The dynamo is by the Electrical Construction Company.

The heavy oil engine—see Fig. 5—of 66 horse-power is noteworthy on account of the fact that although the mean effective pressure is quite moderate and the whole engine is of generous proportions, a high efficiency is maintained. The makers guarantee, for instance, a fuel consumption of 0.42 lb. of oil per brake horse-power per hour when working at full load on fuel of approximately 18,000 B.Th.U. per lb. The arrangement of the fuel pump on this engine is very convenient for inspection and overhaul, as it is fixed on the breech end casting at the end of the cam shaft. The plunger is driven through an enclosed vertical rocking lever, and the valves are two plain nickel steel balls. The stroke of the pump is constant and the amount of oil delivered to the spray is regulated by by-passing so much as is not required for the load on the engine. The by-pass is, of course, controlled by the governor. The crank shaft bearings are supplied with oil by ring lubrication. A force feed lubricator driven by the side shaft gives a positive supply of oil to the cylinder, piston pin and crank pins of the engine. A self-contained force feed pump is fitted, the oil being fed to the various points through copper pipes with glass sight feeds attached to each individual pump discharge. In this way the supply of oil is under observation and can be regulated with ease. The arrangement is such that different grades of fuel may be used in the lubrication of the crank pin and the cylinder. The pump automatically starts and stops with the engine.

Ruston and Hornsby, Limited, of Lincoln, have a stand on which there are shown at work two engines. One of them, which is illustrated in Fig. 3, is of the cold-starting, solid-injection type, which has already been described in THE ENGINEER, but is of a size which we have not previously illustrated. It has, it will be seen, two cylinders, and is rated at 110 brake horse-power when running at 300 revolutions per minute. The general construction is similar to that of the engines of which we have already given details.

A little lighting set also shown running on the Ruston stand comprises a paraffin engine of 3 brake horse-power, coupled directly, through a flexible coupling, to a 1½-kilowatt dynamo. The engine is of the makers' standard type, except that it has an extra-heavy fly-wheel, and runs at 450 revolutions per minute. It is, by the way, started with petrol, and is then switched over to paraffin. The general arrangement has been carefully thought out, so that the engine can be attended by comparatively unskilled labour, and there are only two lubricators which need refilling while it is at work.

Condenser Tube Corrosion.

IT was suggested, at a recent meeting of the Liverpool Engineering Society, that the insides of condenser tubes should be coated with some form of enamel to prevent corrosion.

The occasion was when Mr. J. Austin read a paper on "Methods of Preventing Corrosion of Condenser Tubes," in which he described some trials organised with the object of discovering an alloy which would withstand corrosion, and then went on to record the results of an investigation as to the possibility of forming a protective film on the inside of the tubes.

Experiments were carried out by pouring solutions of different composition through tubes, and it was found that the coating supplied was uneven, too thick in some places, and not covering the tube at all in others. Squeegeeing by a rubber pad did not spread the solution evenly, and finally this method of coating was given up as unsatisfactory. It was then decided to experiment by spraying the solution into the tube by means of compressed air, and endeavours were made to adapt an ordinary paint sprayer for the purpose. It was considered impracticable to spray the tubes, which are about 10ft. long, from one end only. An extension nozzle, 5ft. 6in. long, was therefore designed to fit on to the nozzle of the spraying gun, the intention being to spray the tubes from one end and then to repeat the operation from the other end, thereby coating the whole of the interior.

After various experiments and alterations, an extension nozzle was devised which, together with certain adjustments in the pressure of the compressed air and the pressure of the solution in the container, gave the desired results. This, of course, was only possible when the most suitable solution was discovered. Numerous solutions were tried, and it took a considerable amount of experimenting before a bitumastic one was evolved which, as well as being easily sprayed and moderately quick drying, retained all its tenacious and protective properties.

The air compressor used was of the vertical single-acting air-cooled belt-driven type with an automatic suction release, giving 7.5 cubic feet free air per minute at 300 revolutions per minute, 10 cubic feet at 400 revolutions, and 12.5 cubic feet at 500 revolutions per minute. The air compressor is portable and capable of supplying air for two guns at the same time. It was worked in conjunction with an air reservoir 15in. diameter by 30in. high, tested to 60 lb., and fitted with an adjustable safety valve and pressure gauge, connections for air pipes, and a drain cock.

The sequence of operations when treating a condenser which has already been in service is as follows:—

The tubes are first of all thoroughly cleaned. All scale, &c., must be removed to ensure that the solution is applied to the metal. It is also important that the tubes be perfectly dry, and for this reason a slight leak of steam is admitted to the steam side of the tubes just previous to cleaning. After cleaning and drying, the condenser is tested in the usual manner and leaky tubes renewed. A coat of the solution is then applied. Any flooding of the solution at the bottom of the tubes is dealt with by passing a spiral hair brush through the tubes. As soon as the first coat is applied, fans to expedite the drying of the tubes are started up. When dry a second coat is applied, brushed and dried.

When the results of these operations come to be examined it is found that the inner surface of all the tubes is coated with a very thin, smooth, glossy, black coating evenly distributed except on the bottom, where there is a tendency for a small "pool" to form. The operation of withdrawing and replacing the sprayer also causes all the ferrules and tube-plates to be coated with the solution.

In carrying out these experiments it was realised that any coating put on the tubes would be somewhat detrimental to the efficiency of the condenser. In practice it was found to reduce the vacuum from ¼in. to ½in. The overall effect upon the efficiency of the propelling machinery does not, according to the author, show any dropping off, as the fuel consumption and the speed of the ship remain the same, which is probably due to the boiler heating surfaces and the turbine blades being much cleaner.

The experiment, he says, has now proved successful, as out of ten condensers coated with a total of 28,500 tubes, only twenty-one tubes have failed. On examination of these failures it was found that the corrosion which had taken place before the coating was applied was such that it was impossible for the tube to last.

The practicability of coating tubes before being put into the condenser has not been demonstrated, but there would not be any insuperable difficulty in carrying it out. Certain difficulties might be experienced in coating new condensers which have not been in service, as the smooth inner surface of the tubes when new would not offer such a favourable surface for the adhesion of the solution as one which had been roughened through service.

A New Circular Saw Guard.

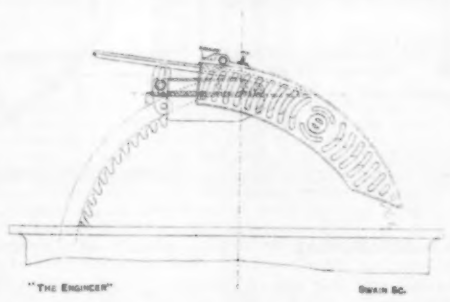
WITH the idea of complying with the more stringent clauses of the new regulations concerning the guarding of circular saws, M. Glover and Co., of Holbeck-lane, Leeds, have recently modified the design of their guard, and the new form is illustrated by the line cut below.

In the Woodworking Regulations of 1922, it should be pointed out, the requirements in this connection are:—

"A curved riving knife set not more than ½in. behind the saw, and securely fastened to a bracket or other means of adjustment below the bench."

"All portions of the blade shall be enclosed or otherwise securely guarded, except the portion of the blade between the bench table and the top guide."

As will be seen from the illustration, the front hood of



the new type of guard is deeper than the old pattern, yet the saw is not so much obscured that the sawyer cannot see all that is necessary of it for the work in hand. An extra adjustable flange, or wing, is also provided, and for ordinary sawing this flange is lowered to cover the gullets of the teeth in the highest position of the saw. In the cut the flange is shown swung to its lowest position. There are, of course, occasions when the sawyer needs to use the whole depth of the saw, and then, instead of it being necessary to raise the whole guard right above the saw, when it would become practically ineffective, only the wing need be swung out of the way.

A new standard, not shown in the illustration, has also been devised for carrying the guard. It comprises a steel column, fixed to the table, on which there slides a sleeve for the attachment of the guard. The sleeve is adjusted for height by means of a rack and pinion, with which there is associated a form of ratchet so arranged that immediately the handle used for operating the pinion is released, the sleeve is locked fast. The rack is free to swing round the column with the sleeve, so that adjustments may be quickly made in any position.

Australian Engineering Notes.

THE Western Australian Minister for Railways recently stated that during the next two years the department intended to construct at least ten new locomotives at the Midland Junction workshops. Orders have been given for the extra plant required, which would cost £91,000. It was expected that the cost of construction would be about £190,000. The locomotives would be similar to those ordered in England, on which the Federal Government had asked £21,900 duty.

* * * * * *

THE Electric Supply Company of Bendigo (Vic.) has installed two sets of turbo-generators, which will more than double the present capacity and provide for a greater standard of efficiency in the working of the plant. The estimated cost of the installation is £50,000. The new plant consists of two 1750 kVA sets to supply 6600-volt three-phase 50-cycle current. The turbo-generators, rotary converters and transformers are all of English manufacture.

* * * * * *

THE Victorian Parliament has passed an electricity supply bill authorising the application of £1,569,500 towards electricity schemes. Part of the money will be distributed as follows:—Power houses, transmission lines, terminal stations, and other works, £281,000; Morwell (brown coal) open-cut workings, £112,000; Sugarloaf-Rubicon water scheme, £223,000.

THE INSTITUTE OF METALS.

THE annual general meeting of the Institute of Metals will be held in the hall of the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W. 1, on Wednesday and Thursday, March 11th and 12th next. The following programme has been arranged:—On the Wednesday at 10 a.m. there will be a general meeting of members in the hall of the Institution, when the reports of the Council and of the honorary treasurer will be presented, and the results of the ballots for the election of the Council for 1925 and for new members will be declared. A selection of papers will then be presented and discussed. In the afternoon at 2 p.m. a further selection of papers will be presented and discussed. The annual dinner will be held at the Trocadero Restaurant, Piccadilly-circus, W. 1, at 7 p.m.

On the Thursday, March 12th, the general meeting will be resumed in the hall of the Institution of Mechanical Engineers at 10 a.m., when a further selection of papers will be presented and discussed. An afternoon session will be held only if an announcement is made to this effect at an earlier session.

The following communications are expected to be submitted:—(1) H. T. Angus and P. F. Summers, "The Effect of Grain size upon Hardness and Annealing Temperature." (2) S. L. Archbutt, "A Method of Improving the Properties of Aluminium Alloy Castings." (3) G. L. Bailey and R. Genders, "The Density and Constitution of the Industrial Brasses." (4) T. G. Bamford, "Comparative Tests on Some Varieties of Commercial Copper Rod." (5) E. A. Bolton, "The Removal of Red Stains from Brass." (6) Denis Bunting, Ph.D., "The Influence of Lead and Tin on the Brittle Ranges of Brass." (7) Ulick R. Evans, "Surface Abrasion as a Potential Cause of Localised Corrosion." (8) J. Newton Friend, D.Sc., Ph.D., and J. S. Tidmus, "The Influence of Emulsoids upon the Rate of Dissolution of Zinc in Solutions of Lead, Nickel and Copper Salts." (9) R. Genders and G. L. Bailey, "The Alpha Phase Boundary in the Copper-Zinc System." (10) Professor Kotaro Honda, Sc.D., and Professor Ryônosuke Yamada, "Some Experiments on the Abrasion of Metals." (11) Professor Tomimatu Isihara, "On the Equilibrium Diagram of the Aluminium Zinc System." (12) A. L. Norbury, "Note on the Effects of Certain Elements on the Electrical Resistivity of Copper"; and (13) Sir Thomas Kirke Rose, D.Sc., "On the Density of Rhodium."

JUNIOR INSTITUTION OF ENGINEERS.

ON Friday, February 13th, Mr. Loughnan Pendred, M.I. Mech. E., M.I.S.I., delivered the Honorary Member's Lecture, and dealt with a subject of absorbing interest to all those who like to hear the story of the origin and development of an important branch of engineering. The title of the lecture was "Milestones in the Development of the Prime Mover Locomotive." Mr. Pendred had a fine collection of slides to show, there being an illustration of nearly every distinctive type of locomotive, from the earliest to the most modern, including steam turbine and internal combustion engine locomotives. He said that he had inserted the words "prime mover" in the title in order to limit the scope of his lecture to a reasonable amount, but he felt bound to say that, although the reciprocating steam engine had not gone, it was challenged by the new types which were opening a new era. It was a point to be remembered that if all the railways were electrified and were dependent on a few central stations for their power, they would also depend much on trade unionism, and the withdrawal of labour from any of them would have serious consequences.

Dr. Alexander Russell, President of the Institution, occupied the chair. Mr. W. J. Tennant, Mr. A. W. Marshall, and Mr. A. S. E. Ackermann, Mr. Poultney and others spoke of the interest they had taken in the lecture, and added one or two remarks about some of the particular types of locomotives.

Fixing a Circulating Water Screening Plant.

AN interesting piece of work was recently carried out in connection with the design and fixing of the circulating water screening plant for the Belfast Corporation's new electric power station. The station is situated right on the harbour side, and the supply of circulating water is drawn from the harbour, the intake being a partially closed culvert of concrete and pile construction. The culvert passes through the quay wall and projects beyond it a few feet. The screen employed had to be so designed that it could be erected right on the face of the culvert in the harbour water. Very costly building work would have been required to provide a dry chamber for the reception and erection of the screen, and, naturally, the harbour authorities could not permit the construction of a building which stood out any distance from the quay wall. As a matter of fact, the limit of projection actually sanctioned was 6ft. 9in.

The Corporation decided to drive piles for the support and protection of the screen, which, it was determined, should be lifted bodily and lowered into the water a little in front of the position it was finally to occupy, and to employ jacks to force it into place, the jacks being permanently retained to keep it there.

The work of designing and constructing the screen and of fixing it in position was entrusted to F. W. Brackett and Co., Limited, of Colchester. The disc type of screen was chosen as being the best suited to the particular conditions, and a special type of steel housing, which would support the disc adequately so that it was free to revolve when in position, and which would at the same time serve as a sealing wall at the entrance to the intake, so that the only passage for the water should be through the meshes of the screen, was got out. As can be well understood, careful design was necessary since the clearance between the revolving rim of the disc, which is 27ft. in diameter, and the surrounding steel work had to be very small, in order that the passage past it of floating matter might be prevented.

There is no need for us to describe the strainer disc itself, for it is of Messrs. Brackett's standard self-cleaning type, with which our readers are familiar. We may say, however, that it is designed to deal with 4,650,000 gallons of circulating water per hour, at average low water level, which allows of an immersion of about 8ft. It is equipped with duplicate driving gears and cleaning-water pumps, which are of the centrifugal type, gears and pumps being operated by two electric motors, each motor driving one of the pumps and one set of disc-driving gear. The driving gears are operated through reduction gear, which, though both of the same type, are of different ratios, so that the disc can be run at one of two speeds, whichever may be deemed the better to suit prevailing conditions.

The screen and its housing were erected on the quay—see Fig. 1—and when a favourable conjunction of tide and weather occurred, the complete structure was lifted bodily by means of slings—see Fig. 2—and lowered into position. It is interesting to note that Messrs. Harland and Wolff's 250-ton floating crane was requisitioned for the operation, and that the lowering was effected without hitch.

We give in Fig. 3 a drawing showing the disc and its housing in position. It will be noted that in ordinary times the disc will have to operate with a difference between high water and low water level of just over 8ft. 6in., while the difference between the highest recorded high and low water levels is nearly 16ft. 6in.

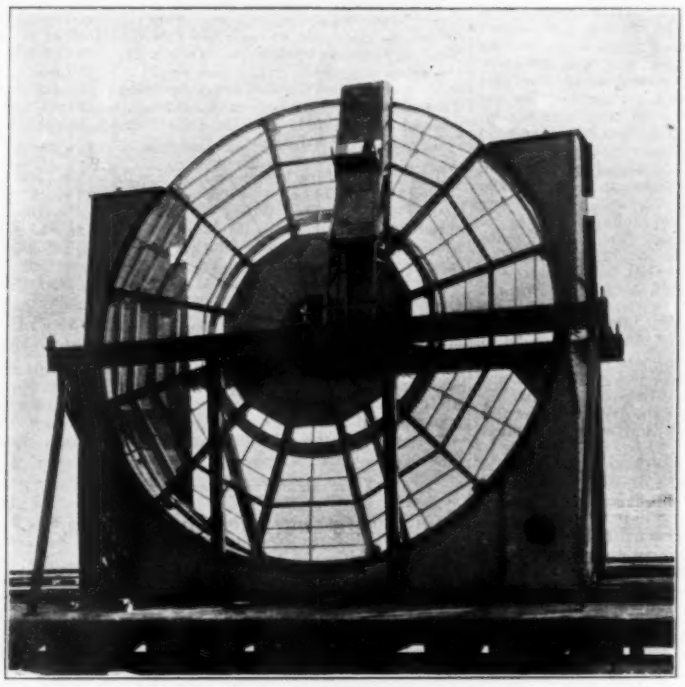


FIG. 1 SCREEN ERECTED ON THE QUAY

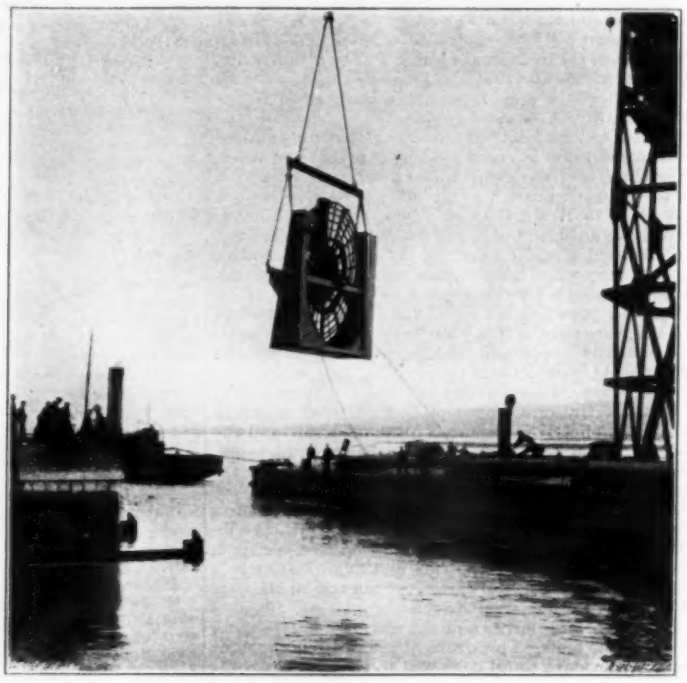


FIG. 2—SWINGING SCREEN INTO POSITION

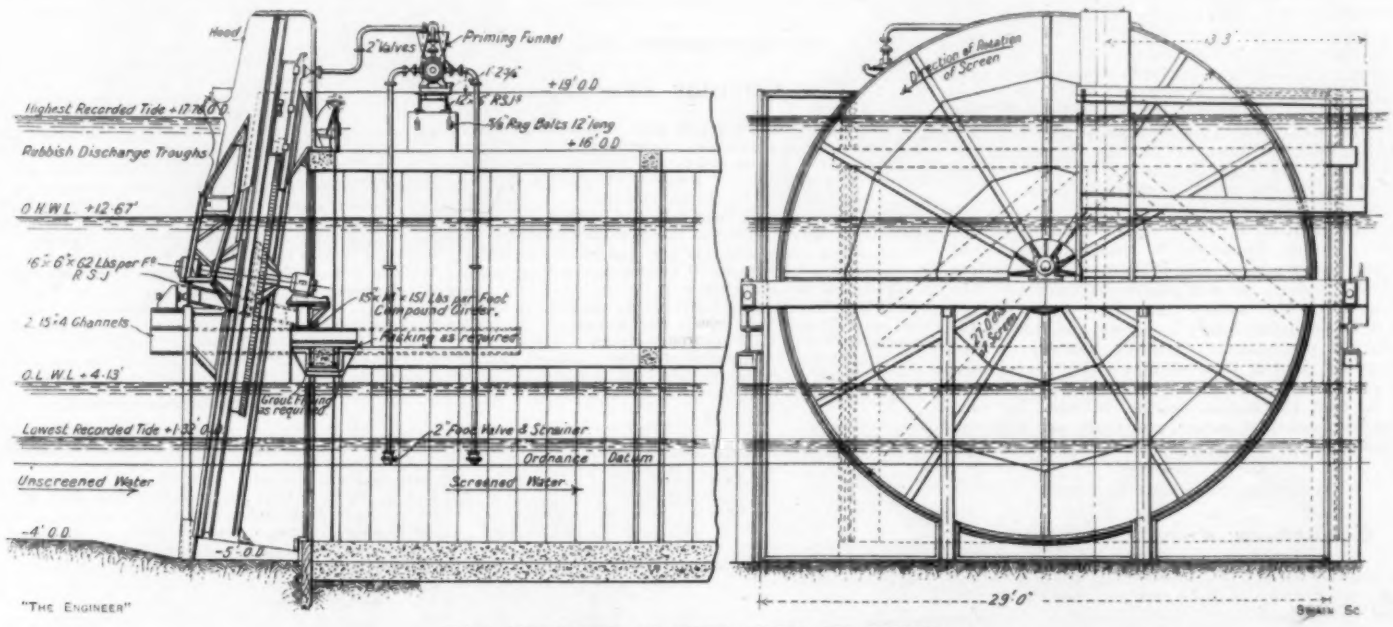


FIG. 3—ARRANGEMENT OF WATER SCREEN AND HOUSING

It is announced that Mr. G. S. Lynde has been appointed chief mechanical engineer to the New Zealand Government Railways.

VACANCIES FOR AIRCRAFT APPRENTICES.

THE Air Ministry announces, in continuation of the policy of training aircraft apprentices in the skilled trades of the Royal Air Force, that two examinations for the entry in September next of 700 suitable boys will be held within the next few months. The "Open Competition" conducted by the Civil Service Commissioners, Burlington-gardens, London, W. 1, will take place on April 17th, and the closing date for the receipt of completed forms of application is March 5th. Candidates with special claims on account of their fathers' service in his Majesty's Forces who have not already applied for a "Service Nomination" should forward full particulars to the Secretary, Air Ministry (M.1), Kingsway, London, W.C., before February 25th.

The "Limited Competition," which is carried out by the Air Ministry in conjunction with the local education authorities, will be held on June 2nd. Boys who are still at school should apply to their headmasters with a view to securing a nomination from the education authority responsible for the school. If they have left school they should apply to the Advisory Committee for Juvenile Employment in their area. Boy scouts can apply to the authorities of the Boy Scout Association, and territorial cadets to the officers commanding their units. The form of nomination for this examination must be received by the Air Ministry (A.E.) not later than May 5th.

Candidates must be physically fit and normally between the ages of 15 and 16½ at the time of entry. In certain cases, excluding candidates for entry under the "Open Competition," an extension of the age limit up to 17 years will be considered.

When appointed as aircraft apprentices boys are given three years' training in a skilled trade and general education by civilian schoolmasters during this period up to the standard of a good technical school. The principal trades open to boys, who are invited in advance to indicate their

preference, are those of carpenter, fitters-aero-engine, fitter-driver, fitter armourer, coppersmith and wireless operator mechanic. In assigning boys to the various trades every endeavour is made to give effect to each boy's individual preference, the wishes of the boys in this respect being considered in the order of their position on the examination list.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Situation Unchanged.

IN the iron and steel industry of the Midlands and Staffordshire there is no material improvement to record, though on 'Change in Birmingham to-day—Thursday—the market tone showed a slight improvement. There was, however, very little business actually transacted. Prices are too irregular to tempt consumers, and they are buying only for immediate needs and on the best terms producers, anxious to dispose of their output, are prepared to give them. Generally speaking, plant is working at considerably less than capacity. Railway business is still disappointing in its yield, but better things are looked for in this direction. Midland iron and steel masters continue to hope for a revival in business in the near future, despite the disappointing conditions which have ruled so far this year.

Finished Iron.

The Staffordshire finished iron trade shows little sign of improvement, and as the weeks go by ironmasters become less hopeful. As I recorded in my letter last week, activity is restricted almost wholly to the production of marked bars, for which a fairly good demand is maintained. Crown bar makers are quite unable to compete with continental competitors for the very small orders which occasionally come on to the market. The same applies to producers of nut and bolt bars. Though the Black Country nut and bolt makers are rather busier in connection with the large wagon building orders now in hand, they are getting most of their bar iron from Belgium. They complain, however, that while the foreign article is about £4 per ton less than Staffordshire mills quote, there is barely any profit margin when it has been worked up. Many Staffordshire mills are engaged in steel re-rolling, and are using for the most part continental semis. The wrought iron strip department continues to make headway and prices are firm at £13 2s. 6d.

Galvanised Sheets.

The Midland sheet mills are fairly active, and deliveries of galvanised sheets can be obtained more promptly than was the case a month or so ago. Values are easier again this week, prices ranging between £17 and £17 5s. for 24-gauge corrugateds. This is fully 2s. 6d. per ton lower than mills were prepared to accept a week ago. Sheets of 30-gauge are quoted £23 15s. Black sheets are selling favourably for a variety of purposes, including hollowware, motor building, stamping and other requirements.

Raw Iron.

In the Midland pig iron department trade is hardly sufficient to absorb the output, and there is little hope of idle furnaces getting into employment. Several Staffordshire works have now been idle continuously for five or six months, and others are only partially employed. The imminent expiration of some pig iron contracts has brought forward a few inquiries for replacement. With the market deterioration persisting, consumers have no anxiety as to future supplies. Though furnacemen are willing to shade prices comparatively little business is to be obtained. The transactions entered into on 'Change in Birmingham to-day were generally for quite small lots and at slightly weaker prices. Though last week's quotations were in some instances upheld the level of values fell about 6d. per ton all round. For Northamptonshire No. 3 foundry iron £3 15s. was accepted, while Derbyshire foundry changed hands at £4. Foundry sorts were likewise cheaper. Blast-furnace coke is plentiful, but there is no change in price.

Steel.

There is no material change in the situation in the steel department. In the constructional section among the new inquiries are schemes for bridge building, the construction of piers, jetties, pipe lines, &c. Prices of angles continue irregular, sellers "cutting" freely to secure desirable contracts. Foreign prices are slightly firmer, following a little recovery in the franc, and a number of steel works are well booked until April. Business is not being keenly sought in this conutry. Quotations are still substantially below English prices. Birmingham constructional engineers have fair inquiries, but are badly handicapped by the ability of their competitors in Wales and on the North East Coast to get their steel plates at £9, against £9 15s. charged to Birmingham engineers. So far the appeals to the manufacturers for some approach to uniform treatment have not been successful, and the engineers are not very hopeful that their representations will have any substantial effect. In the semi-finished department prices are unchanged. Soft billets are quoted at £7 5s. upwards by home producers. Belgian billets are on offer at £6 5s. to £6 7s. 6d., but they attract little attention. Steel scrap business is very slow, the South Wales works taking much below the normal quantity. Prices do not weaken, however, the quotation for South Wales being £3 17s. 6d. to £4. Holders of material are unprepared to accept the very low bids that are made.

Light Casting Price Advance.

"Increased labour cost" is the reason assigned by the National Light Castings Association—with headquarters in Birmingham, controlling practically all the iron-founding trade of the country—for a rise in price of nearly every form of metal work used in house building. The increase of price amounts to from 5 per cent. to 7½ per cent. in the main categories and to more in some cases. The action of the Association in advancing prices at the present moment is severely criticised in Midland industrial circles, and it is pointed out that since the old basis was formulated by the Association two years ago, both pig iron and fuel have become cheaper. Foundry pig iron was then fetching over £4 10s. a ton, and prices were stiffening. To-day foundry pig is being sold at £3 15s. to £4 1s. and the market is weakening. There have, of course, been frequent complaints on the part of iron-founders that they were not getting a fair margin of profit. The schedule of prices fixed two years ago was regulated by the fact that foundries outside the Association were outbidding those inside. The National Light Castings Association, to meet this opposition, cut its prices, but it is stated that since then the outside foundries have been able to go one better than the combine when desirable business turned on the price. No intimation has been given by unassociated foundries of any advance in their prices.

January Production.

The report of the National Federation of Iron and Steel Manufacturers as to iron and steel production in January is considered by manufacturers in the Midlands to be fairly satisfactory, taking into account the conditions which prevailed at the opening of the year. The production of pig iron, amounting to 569,400 tons, compared with 580,300 tons in December and 636,000 tons in January, 1924, is better than had been expected, and the fact that the furnaces in blast at the end of the month showed a net increase of five is taken as indicative of the hopes which blast-furnacemen have of a future improvement in the demand. It is interesting to note that the production included 188,100 tons of hematite, 161,800 tons of basic, 156,900 tons of foundry, and 30,000 tons of forge pig iron. The output of steel ingots and castings amounted to 605,100 tons, compared with 551,000 tons in December and 694,300 tons in January, 1924.

Drainage Board's Proposed Extension of Plant.

The Birmingham Tame and Rea Drainage Board is contemplating extending its sewage purification works at Minworth, owing to the increased volume of sewage arriving there daily, and also owing to the improving condition of the river Tame, into which the Board's effluent is discharged. The Board's Works Committee proposes that the extension should take the form of an addition to the present bio-aeration plant; and it recommends the Board to authorise the expenditure of the sum of £40,380 on this work. The committee also recommends a scheme for sludge treatment by which power costs will be reduced from £1000 per annum to £570. The estimated cost of the proposals is £18,430, but the adoption of the scheme is recommended in view of the saving which will be effected.

Copper Coins for Lithuania.

The King's Norton Metal Company, of Birmingham, has secured an important contract in connection with the new Lithuanian coinage. The contract is for the minting of copper coins to the number of 142,000,000, the weight being 126,200 kilos.

Ironfounders Busy.

Midland ironfounders report steady activity in both sections of the light castings trade. Rough and unfinished castings, which include rainwater goods and various domestic fittings, have been in growing demand since the opening of the year. There is likewise unrelaxed pressure in fitted and finished goods, such as portable ranges, registers, mantles, portable boilers and combination grates. It is expected that with the acceleration of house building the productive capacity of the foundries will be fully extended.

Cannock Chase Miners' Wages.

The wages of Cannock Chase miners this month show a slight reduction compared with the rates prevailing in January. The fall is attributable to the slackness in the coal trade generally during the last three months of the old year. Stallmen now receive 10s. 5d. per shift when working on the minimum, compared with 10s. 7d. for the previous month and 10s. 3d. for February last year. Other grades of workers engaged in and about the mines are proportionately affected by the decrease in wages for the present month.

Unemployment.

The Ministry of Labour's returns showing the numbers unemployed in the Midlands have shown a steady decrease week by week since the beginning of the year. The current figure of 143,955 is 2374 fewer than that in the last return, and in three weeks the total has decreased by 10,692. There are now registered as unemployed in the Birmingham area 29,577; at Bilston, 2810; Coventry, 1490; Cradley Heath, 4896; Derby, 2043; Dudley, 4109; Leamington and Warwick, 547; Leicester, 4265; Northampton, 1527; Nottingham, 8565; Oldbury, 1689; Peterborough, 646; Redditch, 1204; Smethwick, 4828; Stoke-on-Trent area, 14,314; Stourbridge and Brierley Hill, 4168; Tipton, 2295; Walsall, 5935; West Bromwich, 3363; Wolverhampton, 5631; and Worcester, 2173.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

General Conditions.

THE general conditions of business here this week do not seem to be any more favourable to the markets than they have been since the hope of a New Year revival faded in January. The actual volume of business seems still to be declining, and there is a certain amount of weakness all round. The threatened collapse of the French exchange is taken as a sinister sign, although it is still hoped that energetic measures will be taken to prevent a catastrophe. There is also an uncomfortable feeling here in connection with the engineering position. Manchester trade in iron and metals depends so much upon this industry that merchants are naturally disinclined to make contracts for the purchasing of material until they know positively that a stoppage in the engineering industry will be avoided. There can scarcely be a question of improvement while this uncertainty is hanging over the market.

Metals.

There has been some slackening recently in the amount of trade in the non-ferrous metal market here, perhaps partly because of the engineering uncertainty, but more because buyers are by no means certain that prices are secure. It is difficult to see how there can be much danger now to copper prices, although, of course, a small relapse is always possible; but the prices for lead, tin and spelter are obviously vulnerable, and he would be a bold man who took risks either way. Hence the natural tendency on the part of consumers here is to buy what they must have and leave all future needs to the chances of the market. This, of course, tends to restrict the volume of business and gives the market a very quiet appearance. The steady increase in the world's production of copper is a feature which must not be ignored in calculating the chances of the future of prices. It is true that there is a fairly corresponding increase in consumption, and there are various ambitious electrical schemes "in the offing" which may require a large tonnage of copper if they are carried out. The actual productive capacity of the world is, however, fully equal to any probable requirements, if it were developed to its full extent, and this fact may probably prevent prices from rising to any high level. The demand here for scrap copper and metals is, according to reports of dealers, not at all satisfactory. Only comparatively low prices are paid by them when buying, say, about £59 for clean copper scrap and £48 for gun-metal scrap. Tin seems to be rather a steadier market than it was, but, of course, one never knows from day to day what vagaries may occur. There are still some optimists left here who believe, or profess to believe, that tin will again reach £300 per ton. Rather larger supplies are expected to be indicated by the figures at the end of the month; but on the whole the statistics will not be unfavourable. There seems to have been some slight improvement in the demand from the tin-plate trade. Lead has been rather erratic, and it is difficult to form any decided view as to the future. Almost everyone agrees that prices are too high, but no one seems to have the pluck to "bear" the metal. Spelter is a steadier market, but it is very quiet here at the moment.

Pig Iron.

The markets here for foundry iron are easy and quiet. One cannot say that they are definitely any lower than they were, but sellers appear to be rather weaker and are probably more squeezable in the matter of price. The actual demand from the foundries in the district does not increase, and it is generally understood that many works are not too well off for orders for castings; but the main cause of the further weakness in pig iron is probably the fact that orders for castings are taken with no margin or too narrow a margin of profit. As in the steel trade, so in the ironfounding trade, the lack of profit is leading to demoralisation in the prices of the raw material. The truth is that the capacity of the Lancashire district is out of all proportion to the amount of business that is coming in. It is in this disparity that we see and feel the results of the loss of export trade, and it is difficult to understand how the trouble is to be remedied. Sellers of Derbyshire iron for delivery in Manchester and the neighbourhood usually ask 88s. 6d. per ton, but some are accepting 88s., and it may not be long before 87s. 6d. (or 80s. at the furnaces) is the accepted figure. There is a little Lincolnshire, but so little that it commands a premium, although as a rule this iron is not so well liked for foundry purposes as Derbyshire. Before the war Lincolnshire foundry always sold at 1s. less and Lincolnshire forge at 1s. more than Derbyshire. Some Northamptonshire iron is to be had here at about 87s. to 87s. 6d. per ton, but it does not sell freely. For Scotch iron 105s. per ton delivered is the nominal price, but it is becoming more nominal as time goes on. Sellers do not admit that they can take less, but small orders at lower prices are being placed. The total consumption of Scotch iron in this neighbourhood is, however, trifling compared with what it used to be.

Steel.

There is very little new that can be said about the finished steel market. Any orders for heavy steel are keenly contested, and it is only sheet steel that is in fair demand. About £8 15s. delivered here seems now to be the usual price for heavy joists and angles, and £9 15s. for plates; but there are reports that some firms have been cutting the price of plates down to £9 7s. 6d.

Scrap.

Of course, in the present very dull condition of the markets for iron and steel one cannot expect any good demand for scrap materials. The value of steel melting scrap remains round about 65s. on trucks in this district, and the demand for it from the actual consumers is very intermittent. Theoretically 80s. ought to be obtained in Sheffield and this would leave a profit to the dealer who buys at 65s. on trucks. For cast scrap there is a small demand at from 80s. to 85s. delivered, but the weakness of pig iron is affecting this market.

The Engineering Trades.

It cannot be truthfully stated that the hopes which were rather freely indulged in with regard to a general improvement in the engineering trades of this district have as yet shown any tendency to materialise. In fact the tendency with most firms is rather in the other direction. As I have previously mentioned, there are a

few happy exceptions, such, for instance, as the makers of heavy electrical plant, constructional engineers, and several locomotive builders. Apart from these trade is still very flat. What is wanted to produce any real upward movement is foreign trade and a more equal opportunity of competing with continental engineers. In Germany the costs of production, although they have risen quite perceptibly during the last two years or so, are still, I am credibly informed, very much below those in this country, and a similar remark applies to France and Belgium. The general position has no doubt suffered somewhat by the continued depression in the textile industry, which shows no sign of improvement, in spite of the promised increase in the American cotton crops. It therefore behoves Lancashire engineers to exert all their endeavours to pick up what little trade there is to be had.

Concrete Roads in Manchester.

In a paper which was read before the Manchester and District Association of the Institution of Civil Engineers, held in Manchester last week, Mr. C. R. Smith said that with the decrease in horse traffic and iron tired wheels the all-concrete road was the nearest approach to the ideal so far. Although it was slightly higher in first cost than other types of road, experience was proving that it was more economical in the long run. While there were certain disadvantages of concrete construction in the way of resilience, cracks and repairs, time to mature, and colour, the advantages of simplicity, strength, cost of maintenance, cleanliness, and smoothness, surface and salvage value were overwhelming. As they did not disintegrate like water-bound macadam roads, concrete roads made little dust. The smooth surface offered a low resistance to traffic, making it possible to carry greater loads for the same power. Experience had shown that concrete roads were not slippery. When the surface was worn out, if provision were made when the road was constructed and levels arranged to permit it, the concrete would form an excellent foundation for a wearing coat of asphalt, tarmacadam, setts or for another layer of concrete. Mr. Smith said that the roads constructed in Manchester during the last four years had been of the non-reinforced variety and expansion joints had not been used. The alternate bay method was employed, and in the first roads constructed the thickness of concrete was 7in., including a 2in. wearing coat. This type of construction had more than justified itself.

BARROW-IN-FURNESS.

Hematite.

There is an absence of life in the hematite pig iron market, and, if anything, there is less tendency to buy than there was. This certainly applies to those who have been placing orders for delivery in a month or two. Business is now almost confined to orders for immediate requirements. The expected improvement has not come yet to any marked extent, and but for the fact that a considerable amount of iron is going into the steel departments the present output would have to be restricted unless makers were inclined to stock, which is against their present policy. Pig iron at present is bringing little, if any, profit to the maker. The Scotch business is not as good as it has been, but the Midlands are taking a fair tonnage and there is still some going to America. The continental trade is dull, there having been but one dispatch to Antwerp last week. The business in scrap is cut low in view of the amount which is coming from various sources, including Belgium.

Iron Ore.

The iron ore trade is not quite so brisk. There is about the same consumption locally, but there is not as much going out of the district owing to the falling off of the Scotch demand. Foreign ore is in moderate demand. There was a delivery at Barrow of ore from Kirkenes last week.

Steel.

The steel trade continues to be about the same. Orders are still difficult to obtain, but in certain quarters better conditions are hoped for, although the signs of improvement are not very prominent at the moment. There was a further dispatch of rails and fish-plates from Barrow last week to New Zealand in connection with the order which the Barrow Works secured a few months ago and which is about completed. The Workington rail mills have still work to do, but the orders are not heavy. The Barrow rail mills are employed, but fresh orders would be welcomed. The hoop and small section mills are fairly well engaged and foundries are moderately well off for work.

Shipbuilding and Engineering.

Next Tuesday there will be launched from the Naval Construction Works of Vickers Limited the Cunard liner Corinthia. This vessel is similar in size to the Scythia, but internally has been altered from the original designs with a view to making her more adaptable to the big Mediterranean and world tours which her owners now specialise in. Originally she was to have been called the Servia. Only two large vessels are now on the stocks, the Orient liner Otranto and the cruiser Cumberland. The sister ship to the Otranto, the Orama, received a very flattering reception at the various ports she called at on her first voyage to Australia. The Australians appreciate a 20-knot boat on the service. The Orama's performance on the passage out was a remarkably good one. She proved herself a very steady ship in a heavy gale which she ran into when nearing Sydney.

SHEFFIELD.

(From our own Correspondent.)

Continued Depression in Steel.

THE local trade situation shows no improvement, but, on the contrary, appears to grow worse, at any rate as far as business in raw and semi-manufactured materials is concerned. Basic steel is feeling the effects of Belgian competition, and there is almost a complete absence of forward buying, both of that material and of pig iron. The output of billets is on a limited scale, but a good proportion of it has still to be put into stock. In Lincolnshire it has been found necessary to reduce production. The prices of furnace and foundry coke, and also of heavy melting basic steel scrap, are easier. On the manufacturing side conditions are better, but no progress is being made, taking the situation as a whole. A very uneven state of things prevails, some firms doing well while others are badly off for work, but a fair summary of the position appears to be that there is a greater shortness of work and orders than was the case in December. A moderate amount of activity is maintained by the rolling mills, which suggests that some of the finished branches are fairly well placed for work. A good demand exists for certain classes of tools, but orders have been coming in less freely of late, and the future is regarded with some anxiety. The railway steel department continues to be one of the most active, and provides employment for a large number of men. This activity is reflected in a stronger demand for acid steel, and an improvement in the price of the scrap used by the furnaces producing that material. A fair amount of briskness is also reported in the motor steel, cold rolled strip, and edge tool trades.

The Proposed French Tariff.

A more cheerful feeling exists with regard to the threatened increase of French tariffs, which, as I pointed out a week or two ago, would have a most serious effect on Sheffield trade, and against which vigorous local protests have been made. It would seem that the opposition has had some influence with the French Government, for the Bulletin of the British Chamber of Commerce in Paris states that the new Bill appears to have been shelved. This, however, is not absolutely certain, nor is it sure that some increases will not be incorporated in the general revision of the tariff, which has been on the way for several years and may now be expedited.

Price of Light Castings.

A rise in the price of manufactured articles in the light castings industries of Sheffield and Rotherham is announced. This movement is the result of an increase of wages recently arranged in the industries. The advance varies from 5 to 10 per cent., according to the class of product supplied, and affects rain water and fitted goods, including ranges and fireplaces, but baths are excepted. The announcement is not a pleasing one to people interested in the building trade. At present stove grate makers in the district are well employed on standardised patterns of ranges and fireplaces for housing schemes, but are finding the demand for better quality goods very quiet. Although housing schemes are progressing here as in other parts of the country, the building of villas and other private houses is almost at a standstill locally.

Cutlery and Plate.

The export of cutlery in January was rather less than that in December, but an encouraging feature was an improvement in the quantities sent to the Argentine. Imports were also rather less, amounting to £39,190, as compared with £43,373. The chief countries sending these goods over here were Germany and America. A large demand still exists for stainless knives, but severe price cutting continues to affect the trade, and firms with high overhead charges, which make only the best quality, are finding work difficult to obtain. A considerable improvement in the scissors branch is reported. An interesting exhibition of foreign samples, arranged by the Chamber of Commerce in collaboration with the Department of Overseas Trade, has been held in the Cutlers' Hall this week. These exhibitions show the Sheffield manufacturer the quality and style of goods produced by competing countries, as well as the character and price of the articles bought by users overseas. The samples on view this week included Spanish cutlery made from Sheffield stainless steel, ordinary cutlery from France, foreign safety razors and scissors bought in New Zealand, and a very comprehensive collection of penknives produced in the United States. The local plate and cutlery trades have recently booked some heavy orders from catering firms for stainless knives, forks, and spoons, but the ordinary retail trade is quiet, and travellers are not sending good reports in. There is a fair sale for cheap plate, but the demand for sterling silver goods continues poor.

Vickers and Colliery Equipment.

The leading part which Vickers Limited are taking in the production of electric winders for collieries has previously been referred to, and an interesting item regarding this, and other work of the same firm for colliery equipment, has just been published. The electric winder which was exhibited jointly by Messrs. Vickers and the Metropolitan-Vickers Electrical Company, Limited, at Wembley last year has been purchased by the Burradon and Coxlodge Coal Company, Limited, Newcastle-on-Tyne, for its Weetslade pit. Messrs. Vickers have also received an order for four low temperature 4ft. diameter by 50ft. long fusion rotary retorts, to be installed at the Burghlee Colliery, Loanhead, Midlothian, Messrs. W. Hunter and Sons, of Edinburgh, being the consulting engineers. The plant, which is being manufactured at the Barrow-in-Furness works of Messrs. Vickers, will work on colliery waste coal for the purpose of obtaining oil and other products. While on the subject of mining, an interesting point connected with education in the industry may be mentioned. Newton, Chambers and Co., Limited, the well-known coal and iron firm of Chapeltown, near Sheffield, have founded two scholarships of £50 per annum each, tenable for four years at the University of Sheffield. The scholarships will be offered every fifth year to the firm's employees or sons of employees. Holders will be required to take the mining degree or mining diploma course at the University of Sheffield.

Water Schemes.

One of the largest water towers in the country is to be built at Goole, in connection with the scheme for the improvement of the town's water supply. It will be of reinforced concrete, and will hold no less than 750,000 gallons, replacing a tower of brick which has a capacity of only 30,000 gallons. The Goole Urban District Council has placed the contract for the building of the tower with Arnold and Son, Limited, of Doncaster. At Barnsley, too, water developments are proposed, in the form of a new pumping station on the Midhope to Wortley main. At present the town receives 1,800,000 gallons per day from the Midhope reservoir, and it is desired to increase the capacity to 2,500,000 gallons. The Ministry of Health is being asked to sanction a loan of £4000 for the erection of the new pumping station.

A Leeds Station Complaint.

Public authorities in Leeds are dissatisfied with the Wellington Station of the London, Midland and Scottish Railway Company, and are raising an agitation for its improvement. It is complained that the station at present is unworthy of a city of the size of Leeds, and is out of keeping with the building developments that have taken place in and about City-square during recent years. Another point brought forward is that its entrance is not large enough to meet modern traffic conditions, and it is often congested. The Leeds Corporation and the Chamber of Commerce approached the railway company in the matter some time ago, but nothing has yet been done, and they have now decided to make further representations.

NORTH OF ENGLAND.

(From our own Correspondent.)

Trade Drooping.

THE industrial position generally in the North of England is becoming more and more serious, and the outlook is very discouraging. The iron and steel trade is passing through difficult times. The anticipated spring revival has not yet materialised, and although in the pig iron trade producers are selling below the cost of production, they cannot sell all they are making, owing chiefly to the loss of foreign markets. Another blast-furnace has been put out of operation this week, and it is feared that the output will have to be further restricted in the near future. There is also a good deal of uneasiness in the Northumberland coalfield as the result of the closing down of further pits. The directors of the Ashington Collieries—the largest group of pits in the county—have decided to close down a number of seams which are being worked at the Bothal and Carl pits. Altogether 1600 men and boys are to be dispensed with, but serious as that undoubtedly is, it is not regarded as being the most serious factor in the situation. Ashington is acknowledged to be an extremely well-managed concern, and coal of the highest quality is produced. It is felt that if a colliery circumstanced like Ashington has partially to close down the outlook for other districts is poor indeed. Between 800 and 1000 men and youths employed at Garesfield Colliery, High Spen, and the Townley Drift, owned by the Consett Iron Company, have also received notice to terminate their employment.

Cleveland Iron Trade.

The Cleveland pig iron trade continues in a depressed state. The volume of business so far this year has fallen short of expectations, and drooping prices have created a feeling of uncertainty entirely inimical to business activity. The chief trouble is the very limited volume of exports, and the further collapse of the franc does not encourage hope of successful competition with continental producers, who have the temporary advantage of a depreciated exchange. Home consumers, too, have latterly been buying on a hand-to-mouth basis, which leaves the ironmaster in a state of constant anxiety about the disposal of his output. Of course, a substantial proportion of the current production was sold in December last, and even if the present demand be small, it is felt that buyers cannot hold off indefinitely. After all, industry generally is more active than it was a year ago, and probably the aggregate consumption of iron is greater. Moreover, there has come during the past few days a brisk inquiry from Hamburg, and this may be the forerunner of a more active export trade. There is marked disinclination on the part of makers to make further price concessions, and No. 3 G.M.B. Cleveland pig iron is steady at 79s., No. 1 being 84s., No. 4 foundry 78s., and No. 4 forge 77s.

Hematite Pig Iron.

There is no improvement in the hematite pig iron trade, and stocks are accumulating. Only small parcels are being sold at about 86s. per ton for mixed numbers and 86s. 6d. for No. 1.

Ironmaking Material.

The foreign ore trade is in a lifeless state. Most of the works have big stocks of ore and are not disposed to consider further purchases, although best Rubio ore is offered at 22s. per ton c.i.f. Tees. The coke market shares in the general weakness, and there are now sellers of good Durham furnace coke at 24s. per ton delivered at the works.

Manufactured Iron and Steel.

Most of the Northern steel works are working short time, and this section of the trade is also badly in need of a fillip. Orders apparently are being held up and work in hand is steadily diminishing. Makers, however, decline to cut prices any further.

The Coal Trade.

The position in the Northern coal trade is extremely disappointing and is giving rise to considerable anxiety. During the past two or three weeks business has steadily eased off. New business comes forward most sparingly, and each day has seen the position become more difficult. Reports from all centres state that the con-

sumptive demand is very disappointing, with a superabundance of coals on offer from every quarter. All grades of British, American, and German coals are in keen competition, but continental producers can easily undercut British sellers, and thus only a small percentage of orders is secured in this district. Fitters are having a very anxious time and have to strain every nerve to secure sufficient trade to keep the pits at work even on the present moderate scale. They are, however, setting their faces determinedly against further reductions in price, and thus, while all qualities are pressed for sale, prices show little or no fluctuation. Rather than reduce prices any further coalowners are prepared to lay their pits idle, and in many instances this policy is being followed. Northumberland best steam coals are only moderately stemmed, but fitters hold out steadily for 18s. 6d. per ton, while steam smalls show a better tendency, owing to prospects of reduced outputs. Gas coals are in slow demand and speculators are accepting orders at much below the colliery prices, but fitters hold against any concessions. There is no improvement in the coke market. The demand for all makes is dull, and with stocks heavy prices show a weakening tendency.

SCOTLAND.

(From our own Correspondent.)

Uncertain Outlook.

INDUSTRIAL conditions are not improving and the outlook is still most unsatisfactory. Demands for materials continue far from normal on both home and export account, and nothing has happened of late to indicate any early change for the better. Costs of production remain high and the position in this respect has not been improved by the labour attitude in various trades towards hours and wages. Consumers on all hands adhere to a hand-to-mouth policy of buying, and many industrial concerns find great difficulty in securing sufficient work to maintain even a minimum amount of employment.

Pig Iron.

Latest reports from the pig iron trade are discouraging. Inquiries are few in number and small in quantity and stocks in makers' yards continue to accumulate in spite of greatly reduced outputs. The probability is that within the next few days a number of furnaces will be put out of action. Prices of hematite and foundry iron have been reduced and the tendency is still weaker. Continental basic iron is not on offer to the same extent as a week or two ago, but producers here are not reaping any benefit from a slackening of this competition, as consumers are not disposed to anticipate requirements.

Finished Steel and Iron.

So far as can be acertained from the steel works, the position is practically unchanged. Demands anticipated from shipbuilding yards have either not materialised or are most disappointing in volume. Plates are extremely slow and have evidently a poor chance unless specially specified, the home prices being yet considerably above continental quotations. Structural engineers and others have specified quantities of sectional material, but the average turnover remains far below normal. Steel sheets continue to provide the active spot in the steel market. Light black sheets are well booked some time ahead, and the scarcity of orders for heavy sheets is not severely felt at present. Galvanised descriptions are in good demand and the price for flat and corrugated varieties is extremely firm. The bar ironworks are doing very little in iron, home demands being of a scant nature, but the re-rolled steel department is a shade more active. The price of the latter is easier and is somewhere in the region of £8 10s. to £9 per ton, home or export. The demand for scrap material is most irregular and quotations are easier all round.

Coal.

In all districts of Scotland the coal trade is dull and without much promise of improvement. Prompt orders for shipment are extremely difficult to secure, even when price concessions are offered. Forward transactions are almost, if not quite, impossible, as foreign consumers can secure much better terms from continental countries at present. Meanwhile home collieries have a surplus of practically all descriptions of fuel, both large and small, the exception being prime splints, which are still taken up some weeks ahead. The price for these remains at 23s. per ton f.o.b. Glasgow. Treble nuts are extremely plentiful and doubles are hardly any better. Singles and pearls are perhaps a little better off, but hardly sufficient to influence prices. Shipments are declining, cargoes being chiefly against old contracts. Aggregate clearances amounted to 214,552, against 234,199 in the preceding week and 302,288 tons in the same week last year. The home market likewise is unsatisfactory, both industrial and household demands being far below normal, with the possible exception of best house coal.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Outlook.

THE conditions in the steam coal section have by no means been satisfactory during the past week. Tonnage has come along rather better and has slightly improved the position of individual undertakings, but unfortunately there is not the demand from abroad necessary to infuse any life into operations. Those exporters who have coals on contract have the greatest difficulty in finding an outlet for them at a price which will pay them. Only one inquiry of any note has come on the market since I wrote a week ago, and that is one of 150,000 metric tons of large coal for the Egyptian State Railways. Exact particulars as to the period of delivery have not yet come to hand, but tenders have to be in at Cairo on March 22nd. Apart from this the conditions have been very dull, and many collieries, owing to their large stocks, are hard pressed to avoid pit stoppages. As a mater of fact, some have been compelled to suspend working, and very few undertakings can claim to be working fully.

Anthracite Colliery Transaction.

A further deal in anthracite property in South Wales is reported, it being understood that the Raven Anthracite Collieries, Limited, which company secured not long ago the interests of Sir Beddoe Rees in the Garnant district has completed negotiations for acquiring the collieries of the Blaina Company in the Ammanford area. The latter are of considerable importance, and embrace the Pantyffynnon, Park and Saron collieries, at which over a thousand workmen are employed and which produce about 4000 tons weekly. The property is capable of considerable development, and it is believed that it is intended to sink a new pit on the south side of the Loughor River just below the Pantyffynnon Station. The chairman of the Raven Company is Sir Arthur Lewes Dickinson, of London.

Miners and Craftsmen.

Following an executive meeting of the Enginemen, Boilermen and Craftsmen's Association held at Cardiff at the end of last week, it was announced that a general meeting had been held between the committee of the miners' executive and its executive with a view to establishing a firm relationship between the federations, but that the discussion had proved abortive. The National Federation of Mechanics stated that it could not agree to the same conditions of affairs that existed in 1921, and could not undertake to enter into any agreement which would hand over to any other union the authority over the safety men.

Tin-plate Trade Items.

Welsh tin-plate bars and tin-plates have been reduced in price by the Stabilisation Committee. Tin-plates have been reduced 6d. per basis box, making the minimum 23s., basis I.C., f.o.b., and tin-plate bars are down 3s. 6d. per ton to £8 4s. delivered, less 7s. 6d. per ton rebate to the tin works in the stabilisation—prices—scheme. Work is still somewhat irregular at some of the South Wales undertakings, but at the same time a very welcome order of considerable size for oil plates has been placed in the Swansea district by the Asiatic Petroleum Company. This will have the effect of providing considerable additional employment in itself, and it is to be shared between various works. In the case of some mills it is understood that they will be kept busy for several months. It is further expected that immediately an understanding has been come to between makers and merchants, an influx of orders will be experienced and so help to remove the present depression. At a meeting of the Joint Industrial Council for the tin-plate trade held on Saturday last, the annual report recently submitted at the annual meeting was considered. This showed that remarkable progress had been made in the settlement of outstanding questions. The definite announcement is made that Baldwins, Limited, intend commencing at an early date the erection of a new tin-plate works on the Crumlyn Burrows, Swansea, close to their present works in that area. The proposed works will embody the new principle of tin-plate mill, and it is estimated that these new works will consume in the manufacture of tin-plates from 35,000 to 40,000 tons of steel per annum. The foundation work for the new building will shortly be begun.

Tin-plate Trade Differences.

The differences between tin-plate manufacturers and the independent merchants are reported to be on the point of settlement, as the result of a conference in London. It is understood terms regarding merchants' discount have been arranged and now await ratification by both parties. There will be a meeting at Swansea on Tuesday next for this purpose.

Pitwood Agreement.

A new agreement governing the purchase and sale of pitwood has been reached between the Cardiff and Bristol Channel Pitwood Importers' Association and the Bordeaux Syndicate of Pitwood Exporters to replace the agreement made in 1911. One important point in the new agreement is a clause which stipulates that the quality of pitwood supplied shall be sound and merchantable and suitable for colliery use. Recently coalowners had reason to complain about the quality of supplies.

Training for the Sea.

The Cardiff Nautical College is very fortunate in having the support of the well-known shipowner, Sir William Reardon Smith, Bart., who has already done much for the institution. Sir William has now purchased the famous schooner yacht Margherita, which is to be re-rigged and converted into a three-masted auxiliary schooner fitted with two hot-bulb engines. The vessel is expected to be ready in June next, and Sir William intends to give the apprentices at the Cardiff Nautical College the advantage of learning practical seamanship and so helping them to become first-class officers. About 200 apprentices have passed through the College many of whom are now serving on the steamers under the control of Sir William Smith, and at the moment there are about sixty apprentices at the college.

Current Business.

The tone of the steam coal market is very quiet, and new orders are very slow to come to hand. Many collieries are experiencing very great difficulty in keeping going regularly, and owing to the accumulation of stocks, the market is very patchy. Buyers who are able to take quick delivery of coals can secure concessions in prices, but for shipment ahead colliery salesmen decline to take these low figures. Best Admiralty large range about 26s. 6d. to 27s. Superior smalls are fairly steady, but inferior grades are easily obtainable. Owing to the heavy quantities of coals standing wagons have been scarce, and this has operated to the disadvantage of the pitwood market. The price of pitwood has been down as low as 22s. 6d. per ton ex ship, which is the lowest figure touched since the second half of 1914.

CALENDARS, DIARIES, &c.

R. W. CRABTREE AND SONS, Limited, 7, Farringdon-road, E.C. 1.—Desk pad with calendar.

AUGUST'S MUFFLE FURNACES, Limited, Halifax.—Wall calendar with monthly tear-off sheets.

ARTHUR ROSS, HOTCHKISS AND CO., Limited, 1, Glengall-road, Old Kent-road, S.E. 15.—Pocket diary.

WELDECSON PRESS, Limited, 108-110, Clarendon-road, Holland Park, W. 11.—Wall calendar with monthly tear-off sheets.

WILLIAMS, LEA AND CO., Limited, Clifton House, Worship-street, E.C. 2.—Wall calendar with monthly tear-off sheets.

THE ARRIVAL OF THE ROTOR SHIP.—The Flettner rotor ship Buckau, which left the mouth of the Elbe with a cargo of timber about nine o'clock on Saturday morning, February 14th, arrived off Inchkeith about 2.30 on Tuesday afternoon last. She passed close by Leith, and heading for the Forth berthed at Grangemouth late the same evening. It would appear that the crossing was fairly rough, for about 77 hours were taken. The time normally taken by a tramp steamer for a similar crossing is about 50 hours, and schooners have been known to make the voyage in about the same time. The object of the Buckau's voyage was a lengthy sea trial and speed was not the only consideration. Observers have stated that in sight of the coast a steady speed of about 9 knots was made, with a wind practically at right angles to the course of the ship. The absence of wake would seem to indicate that the oil engine propelled screw was not being used, and that the vessel was being entirely propelled by her two revolving towers.

THE INSTITUTION OF STRUCTURAL ENGINEERS.—It having been found by the Science Committee of the Institution of Structural Engineers that time rendered it impossible for the members to deal with the very large number of scientific problems upon which it is felt that reports would benefit the profession, it has been decided to form sectional committees of the Science Committee, to include representatives of the general body of members. Sectional committees have already been formed to deal (*a*) with concrete and (*b*) steel. Mr. R. H. H. Stanger is chairman of the Concrete Committee, and is assisted so far by Messrs. A. C. Davis, Arthur E. Evans, Dr. Faber, H. Gardiner Lloyd, H. E. Steinberg, and J. T. Saunders. The Steel Committee has Mr. S. Bylander as chairman, with the assistance of Messrs. E. S. Andrews, H. Kempton Dyson, E. Fiander Etchells, J. Mitchell Moncrieff, H. J. Collins, and W. A. Green. Further committees to deal with timber (chairman, Mr. H. D. Searles-Wood) and brickwork and masonry (chairman, Mr. E. Fiander Etchells) are in process of formation.

THE INSTITUTION OF GAS ENGINEERS.—At a Council meeting of the Institution of Gas Engineers, held at Grosvenor-gardens on February 9th, an intimation was received from Vice-Admiral Sir Lionel Halsey, G.C.V.O., Comptroller to H.R.H. the Prince of Wales, that his Royal Highness had graciously consented to be nominated an honorary life member of the Institution of Gas Engineers. The President, Mr. J. Ferguson Bell, M. Inst. C.E., proposed that in view of the signal honour conferred on the Institution, the Council should exercise its powers, suspend Rule 4, and elect H.R.H. the Prince of Wales an honorary life member without the formality of submitting the proposal at the annual general meeting of members to be held in June next, as he knew this would be the wish of the members. The proposal was seconded by Mr. Botley, the senior Vice-president, and was unanimously adopted with acclamation. In addition, the President proposed that the Council recommend the Lord Mayor of Manchester, Alderman F. West, J.P., be nominated as an honorary member of the Institution in recognition of his eminent services rendered to the gas industry. This was seconded by Mr. Samuel Tagg, M. Inst. C.E., ex-President, and carried unanimously.

UNIVERSITY OF LONDON: ADVANCED LECTURES IN MINING.—A course of four lectures on "Tubbing Deep Shafts" and "Subsidence" will be giving in the Mining Department of the Imperial College (Royal School of Mines), Prince Consort-road, South Kensington, S.W. 7, by Professor L. Denoël, Professor of Mining in the University of Liége, at 5.15 p.m. on March 16th, 17th, 18th and 19th next. The following is a syllabus of these lectures:—No. I.: The lining of shafts with reinforced concrete or metal tubbing; criticism of the theory concerning strength of tubbings; limit of depth; compound tubbing; shaft sunk by the freezing method. No. II.: Subsidence; extent of the disturbed area; value of mathematical theory; direction of the line of breakage; actual observations; nature of the rocks, inclination of the seams; faults; drainage. No. III.: Rate and duration of settlement; theoretical and practical determination of the amount of subsidence; horizontal movements; methods of working. No. IV.: Damages; loss of mineral wealth; effects on the buildings; suggested rules for the prevention or reduction of damages. The lectures, which will be illustrated with lantern slides, will be addressed to students of the University and to others interested in the subject. Admission will be free, without ticket.

THE INSTITUTION OF ELECTRICAL ENGINEERS: ANNUAL DINNER.—On February 12th the annual dinner of the Institution of Electrical Engineers was held at the Hotel Cecil. There was a large attendance of members, and, as usual, there were many distinguished guests. The president, Mr. W. B. Woodhouse, occupied the chair. Proposing the toast of "The Institution of Electrical Engineers," Sir Arthur Steel-Maitland, Minister of Labour, said that electrical exports were steadily increasing and the home industry was also improving. It was of vital importance that the British electrical industry should keep abreast of America, Germany, and other countries in technical skill and organisation, so that the development in electricity might accrue to the benefit of the country as a whole. In responding, the chairman referred, among other things, to the price of electricity. The average price at which the great power companies sold electricity, he said, was less than a penny a unit, and it only required a continuation of the present growth and development of the demand for the price to be substantially reduced. In proposing the toast of "Our Guests," Sir John Snell referred to statements which had appeared in the Press concerning the intentions of his Majesty's Government with regard to electrical development. In responding to the toast, Lieutenant-Colonel Wilfred Ashley, Minister of Transport, said he did not know on what grounds those statements were made, because the Ministry of Transport had only reached the stage of investigation, and until it had explored every avenue it would be premature for His Majesty's Government to come to any conclusion. Sir Joseph Cook, High Commissioner for Australia also replied.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	17/6 to 24/-
(1) Spanish	23/-
(1) N. African	23/-
N.E. COAST—	
Native	—
Foreign (c.i.f.)	22/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	4 13 6	—
No. 1 Foundry	4 11 6	—
No. 3 Foundry	4 9 0	—
N.E. COAST—		
Hematite Mixed Nos.	4 6 0	4 6 0
No. 1	4 6 0	4 6 0
Cleveland—		
No. 1	4 4 0	4 4 0
Silicious Iron	4 4 0	4 4 0
No. 3 G.M.B.	3 19 0	3 19 0
No. 4 Foundry	3 18 0	3 18 0
No. 4 Forge	3 17 0	3 17 0
Mottled	—	—
White	—	—
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	10 10 0	—
North Staffs. Forge	3 17 6	—
,, ,, Foundry	4 7 6	—
(3) Northampton—		
Foundry No. 3	3 15 0	—
,, Forge	3 10 0	—
(3) Derbyshire—		
No. 3 Foundry	4 0 0 to 4 1 0	
Forge	3 16 0	—
(3) Lincolnshire—		
No. 3 Foundry	4 2 3	—
No. 4 Forge	3 17 6	—
Basic	4 0 0	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	5 0 0 (a)	—
	5 5 0 (b)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	12 0 0	—
Best ,,	—	—
N.E. COAST—		
Common Bars	12 0 0	—
LANCS.—		
Crown Bars	13 0 0	—
Second Quality Bars	12 0 0	—
Hoops	15 0 0	14 15 0
S. YORKS.—		
Crown Bars	13 0 0	—
Best ,,	13 10 0	—
Hoops	14 10 0	—
MIDLANDS—		
Crown Bars	12 15 0	—
Marked Bars (Staffs.)	15 0 0	—
Nut and Bolt Bars	11 15 0	—
Gas Tube Strip	13 0 0 to 13 2 6	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	13 0 0	—
Ship Plates, ¼in. and up	9 15 0	—
Sections	9 10 0	—
Steel Sheets, 3/16in. to ¼in.	12 0 0	—
Sheets (Gal. Cor. 24 B.G.)	—	£18 0 0 to 18 10 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	9 5 0	—
Angles	9 0 0	—
Boiler Plates	13 0 0	—
Joists	9 5 0	—
Heavy Rails	9 10 0	—
Fish-plates	13 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	9 10 0	—
Soft Billets	8 10 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	9 0 0†	—
Light ,,	9 5 0 to 9 10 0	
Billets	8 0 0 to 11 0 0†	
MANCHESTER—		
Bars (Round)	9 15 0 to 10 0 0	
,, (others)	9 10 0 to 9 15 0	
Hoops (Best)	15 5 0	15 0 0
,, (Soft Steel)	13 15 0	13 10 0
Plates	9 10 0 to 9 15 0	
,, (Lancs. Boiler)	13 0 0	—
SHEFFIELD—		
Siemens Acid Billets	11 10 0	—
Bessemer Billets	13 0 0	—
Hard Basic	9 10 0	—
Intermediate Basic	9 0 0	—
Soft Basic	8 0 0 to 8 5 0	
Hoops	12 0 0	—
Soft Wire Rods	11 0 0 to 11 10 0	
MIDLANDS—		
Small Rolled Bars	9 0 0 to 9 15 0	
Billets and Sheet-bars	7 5 0 to 7 10 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	17 0 0 to 17 5 0	—
Angles	9 5 0	—
Joists	9 5 0	—
Tees	10 5 0	—
Bridge and Tank Plates	9 15 0	—
Boiler Plates	13 10 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	23/- to 23/6
Block Tin (cash)	262 15 0
,, (three months)	266 15 0
Copper (cash)	64 7 6
,, (three months)	66 7 6
Spanish Lead (cash)	37 5 0
,, (three months)	36 7 6
Spelter (cash)	36 10 0
,, (three months)	35 17 6
MANCHESTER—	
Copper, Best Selected Ingots	69 10 0
,, Electrolytic	70 10 0
,, Strong Sheets	96 0 0
,, Tubes (Basis Price)	0 1 1½
Brass Tubes (Basis price)	0 1 0½
,, Condenser	0 1 2½
Lead, English	40 0 0
,, Foreign	38 10 0

FERRO ALLOYS.

(*All prices now nominal.*)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/8½ per lb.	
Ferro Tungsten	1/4½ per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£24 0 0	8/-
,, 6 p.c. to 8 p.c. ,,	£23 10 0	7/9
,, 8 p.c. to 10 p.c. ,,	£23 0 0	7/6
,, Specially Refined		
,, Max. 2 p.c. carbon	£42 0 0	16/-
,, ,, 1 p.c. ,,	£51 0 0	17/6
,, ,, 0.75 p.c. carbon	£57 0 0	20/-
,, ,, carbon free	1/5 per lb.	
Metallic Chromium	4/- per lb.	
Ferro Manganese (per ton)	£15 for home, £15 for export	
,, Silicon, 45 p.c. to 50 p.c.	£12 10 0	scale 5/- per unit
,, ,, 75 p.c.	£19 17 6	scale 6/- per unit
,, Vanadium	17/- per lb.	
,, Molybdenum	7/6 per lb.	
,, Titanium (carbon free)	1/- per lb.	
Nickel (per ton)	£175	
Cobalt	10/- per lb.	
Aluminium (per ton)	£130	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	16/9
,, ,, Ell	18/6
,, ,, Splint	19/- to 23/-
,, ,, Trebles	17/6
,, ,, Doubles	16/6
,, ,, Singles	14/6
AYRSHIRE—	
(f.o.b. Ports)—Steam	16/9
,, ,, Splints	19/-
,, ,, Trebles	17/6
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	14/9 to 17/-
Screened Navigation	24/-
Trebles	16/6
Doubles	16/-
Singles	14/6
LOTHIANS—	
(f.o.b. Leith)—Best Steam	16/9
Secondary Steam	15/9
Trebles	17/-
Doubles	15/3
Singles	13/9

ENGLAND.

	Inland.	Export.
(8) N.W. COAST—		
Steams		28/6
Household		45/- to 58/4
Coke		30/-
NORTHUMBERLAND—		
Best Steams		18/6
Second Steams		17/6
Steam Smalls		10/6
Unscreened		15/6 to 16/6
Household		23/6 to 25/-
DURHAM—		
Best Gas		21/-
Second		18/- to 18/3
Household		23/6 to 25/-
Foundry Coke		23/- to 23/6
SHEFFIELD—		
Best Hand-picked Branch	30/- to 33/-	—
Barnsley Best Silkstone	26/- to 28/-	—
Derbyshire Best Brights	26/- to 31/-	—
,, ,, House	24/- to 26/-	—
,, ,, Large Nuts	22/6 to 25/-	—
,, ,, Small	14/- to 16/-	—
Yorkshire Hards	19/6 to 23/-	—
Derbyshire ,,	19/6 to 22/-	—
Rough Slacks	10/- to 12/6	—
Nutty ,,	9/- to 10/6	—
Smalls	4/- to 6/6	—
Blast-furnace Coke (Inland)*	—	—
,, ,, (Export)	f.o.b.	20/9 to 21/9

(9) SOUTH WALES.

CARDIFF—	
Steam Coals :	
Best Smokeless Large	26/6 to 27/-
Second ,, ,,	25/- to 26/-
Best Dry Large	25/6 to 26/3
Ordinary Dry Large	24/- to 24/6
Best Black Vein Large	24/- to 24/6
Western Valley ,,	23/- to 24/-
Best Eastern Valley Large	23/- to 24/-
Ordinary ,, ,,	22/6 to 23/-
Best Steam Smalls	16/- to 16/6
Ordinary ,,	13/- to 15/-
Washed Nuts	22/- to 32 -
No. 3 Rhondda Large	27/- to 27 6
,, ,, Smalls	19/- to 20 -
No. 2 ,, Large	22/6 to 23 6
,, ,, Through	18/- to 20 -
,, ,, Smalls	11/- to 13 -
Foundry Coke (export)	40/- to 47/6
Furnace Coke (export)	25/- to 30/-
Patent Fuel	25/- to 27/-
Pitwood (ex ship)	22/6 to 23/6
SWANSEA—	
Anthracite Coals :	
Best Big Vein Large	45/- to 47/6
Seconds	35/- to 37/6
Red Vein	32/6 to 35/-
Machine-made Cobbles	47/6 to 52/6
Nuts	50/- to 52/6
Beans	44/- to 45/-
Peas	20/- to 23/6
Breaker Duff	9/- to 9/6
Rubbly Culm	10/- to 10 6
Steam Coals :	
Large	24/- to 25/6
Seconds	22/6 to 24/6
Smalls	11/6 to 14/-
Cargo Through	17/- to 19/-

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. * For blast-furnaces only, 16/9, with fluctuations according to analysis; open market, 18/- to 19/- at ovens. † Latest quotations available. (a) Delivered Sheffield or Glasgow. (b) Delivered Birmingham.

French Engineering Notes.

(From our Correspondent in Paris.)

The Trade Situation.

THE outlook for the manufacturing industries is being seriously affected by the financial situation, which is becoming steadily worse in consequence of the various measures the official mind is seeking to impose in an effort to make things better. Instead of allowing finance and industry to work out their own salvation under cover of an economic policy that would inspire confidence all round, the present socialist legislators are endeavouring to apply a cut-and-dried remedy of their own. The restrictions and reforms that constitute their remedy are only giving rise to a feeling of distrust. The currency continues to depreciate, the cost of everything is advancing, and it is now rumoured, though not yet confirmed, that the Government has required the Bank of France to suspend all discount business. Whether or not there is anything in the rumour it has certainly affected business, for should the leading bank withdraw discount facilities, trade will lose its principal element of activity. Many enterprises are being held up until the situation becomes clearer. The object of the Government is to prevent any further currency inflation by checking the issue of notes which is already very near the legal maximum. Should that limit be exceeded nothing can stop a continuous fall in the value of the franc.

Refuse Disposal.

The recent resignation of the municipal council of Meudon, as a protest against the proposal to install an incinerating plant in that charming suburban locality, has revived interest in the work being done by the Paris municipal engineers for the disposal of the 700,000 tons of house refuse which are collected in the city every year. In this respect more has probably been done in Paris during the past four or five years than anywhere else. Before then, the greater part of the refuse was conveyed beyond the suburbs and dumped down at railway sidings, whence it was spread out over the neighbouring fields as manure. The refuse is now all collected in big motor wagons with sliding panels on top which completely cover the load. After being discharged into a trench at the works the refuse passes between gangs of pickers on each side of conveyors to disintegrators and to the furnaces, and, while a part of the refuse is reduced to powder and put into sacks to be sold for fertilising purposes, the remainder is burned in the incinerator. The clinkers are employed almost entirely for the manufacture of bricks for building purposes. As soon as the four incinerating plants at St. Ouen, Issy-les-Moulineaux, Romainville and Ivry are sufficiently equipped, the whole of the refuse will be burned. The plants will eventually be able to deal with 1,200,000 tons of refuse a year.

Reconstruction.

The total cessation of work in the liberated regions created a state of things which compelled the Government to see whether something could not be done to satisfy the contractors and others who refused to continue the work of reconstruction unless they were offered something more acceptable than bonds redeemable in ten years. Meetings held during the past week revealed that there could be no hope of any solution that did not provide for payments in cash and in State securities. As the stoppage of operations in a district which has been contributing so largely to the general activity would prove disastrous at a time when the situation all over the country is more or less precarious, the Government has been obliged to promise immediate satisfaction, and has prepared another estimate for the liberated regions, whereby a sum of a milliard francs in cash will be distributed this year for building purposes.

State Railway Control.

The railway companies have already taken measures to resist the attacks being made upon their independence by the present socialist Government, first, by informing the Minister of Public Works that they intend appealing to the High Courts in the event of the Bill requiring all official appointments to be submitted to the approval of the Government passing through Parliament; and, secondly, by appealing to the Conseil d'Etat against the alleged illegality of the State applying the eight hours' working day to those engaged in sedentary occupations on the railways. The companies affirm that the latter decree will add considerably to the already heavy financial burdens imposed upon them at a time when the withdrawal of the State guarantee throws them entirely upon their own resources. The Minister of Public Works argues that the additional burden is exaggerated by the companies and cannot exceed 60 million francs, which, nevertheless, appears to be a sufficiently formidable figure, and the Minister expects the companies to recoup the increased expenditure arising out of the application of the laws for the benefit of the railwaymen by raising the railway rates. This question is now under discussion, and it is found practically impossible to raise the rates any further.

Refloating the Liberte.

After working patiently for three years upon the wreck of the battleship Liberté, which blew up in September, 1911, with the loss of more than 400 lives, the hull has been floated and removed from the place in Toulon Harbour, where it was for so long a time a hindrance to navigation. It sank on a mud bottom in front of the Monisséques. Everything possible was removed from the wreck and the superstructure was cut away, and when only the empty hull was left it was made air-tight and raised by compressed air. It was then attached to the old cruiser Latouche-Tréville, which had served as a workshop during the operations, and was towed for 1500 m. to the dry dock where it is to be broken up.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

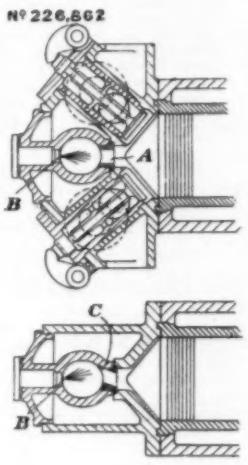
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

226,862. September 22nd, 1923.—COMBUSTION CHAMBERS, S. J. Fielding, Atlas Works, Gloucester.

This invention relates to internal combustion engines of the four-stroke type, in which the fuel is injected at the end of the compression stroke into a combustion chamber in the cylinder by a comparatively narrow neck inclined to the cylinder axis, and a primary object of the invention is to secure the maximum

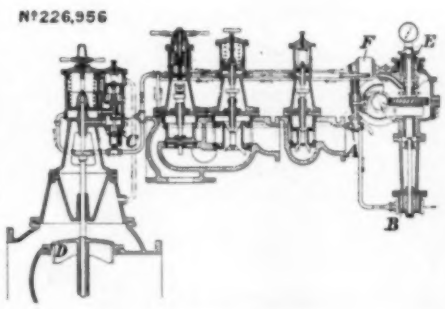


amount of turbulence within this combustion chamber during compression. The combustion chamber A, into which the liquid fuel is sprayed through a fuel sprayer B, has its axis directed towards the inlet end of the contracted neck C. The latter is asymmetrically disposed with respect to the axis of the cylinder, that is to say, its end opening into the cylinder is offset from the cylinder axis.—*December 22nd*, 1924.

TURBINE MACHINERY.

226,956. December 11th, 1923.—GOVERNING STEAM TURBINES, Daniel Adamson and Co., Limited, Dukinfield, J. Gilmour and J. W. Green.

There are three claims in this specification, one for the introduction of a release valve A, operated by the run-away gear, which by-passes the oil supplied by the pump B for working the



servo-motors of the several admission valves and consequently allows them to shut very rapidly when the emergency governor acts. The second claim is for a dashpot C, working in conjunction with the relay valve of the low-pressure admission valve D; while the third is for an automatic clutch-like arrangement which permits of the governor being adjusted either by the hand wheel E or the remote control motor F.—*January 8th*, 1925.

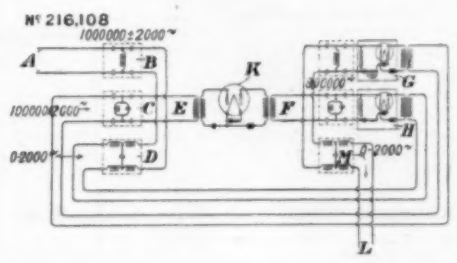
TELEGRAPHS AND TELEPHONES.

226,692. January 29th, 1924.—IMPROVEMENTS RELATING TO THE LOADING OF ELECTRIC CABLES, Siemens Brothers and Co., Limited, of Caxton House, Tothill-street, London, S.W. 1, and Arthur Ernest Foster, of Fairlawn, Old Charlton, London, S.E. 7.

This invention refers to the manufacture of continuously loaded conductors, such as are used for telegraphic or telephonic transmission. It has been proposed to load conductors of cables by embedding a magnetic material in the dielectric of the cable; the magnetic substance in a finely divided state being incorporated in the dielectric which is applied to the conductors of the cable. In order to give sufficient inductance to overcome the effect of capacity of a submarine cable, such a high percentage of magnetic material is required in the compound that the insulating properties of the dielectric are undesirably affected, and chains of the small particles of conducting material may extend across the dielectric. If the amount of magnetic material is reduced to ensure good insulation, the loading is usually not great enough even though the material used has a high permeability. The present invention provides means for continuously loading an electric conductor, whilst preserving a high insulation resistance. The method employed is to apply a compound consisting of a binder and magnetic material in powder state to the conductor, and to cover the conductor loaded in this way with a layer of insulating material. The magnetic material may be iron in a finely divided state, or iron alloyed with another metal or metals, the alloy not having a lower permeability than iron at the low magnetising forces occurring in telegraphic or telephonic transmission. The binder which incorporates the magnetic material may be gutta percha or balata. The outer coating of insulating material may be gutta-percha, balata, rubber or admixtures of these, the thickness of the covering depending on the capacity and insulation required.—*January 1st*, 1925.

216,108. May 15th, 1923.—IMPROVEMENTS IN CIRCUITS FOR THE REPEATED AMPLIFICATION OF ELECTRIC SIGNALLING CURRENTS, *The Western Electric Company, of Connaught House, Aldwych.*

According to this invention, the energy to be amplified is passed through an amplifier successively at different frequencies, so that the energy is amplified a number of times by a single amplifier. A full description of the invention cannot be given in a few words. Briefly, between each transmission through the amplifier the frequency is shifted in some well-known manner, as, for example, by modulating it with a carrier frequency. In the diagram the energy is received at A. Filters are arranged at B, C, D. The frequencies which these filters are designed to

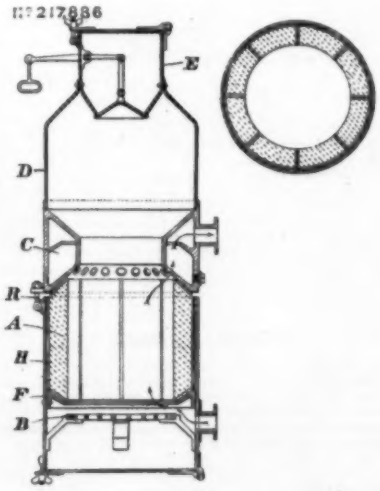


pass are indicated on the diagram. In the case of the filter B, for instance, the carrier frequency is 1,000,000, plus or minus band of 2000 cycles representing the voice signalling wave in accordance with which the carrier is modulated. This total band of 4000 cycles is impressed upon the circuit E leading to the amplifier. After being amplified it is passed into the outgoing circuit F, leading to other filters and modulators G and H. The ultimate effect of the arrangement is that the energy is passed through the amplifier K successively at different frequencies and finally the energy is delivered into the outgoing circuit L. The filter M selects from the circuit F the final low-frequency energy and transmits it to the final receiving circuit L.—*January 8th*, 1925.

GAS PRODUCERS.

217,886. April 22nd, 1924.—GAS PRODUCERS FOR AUTOMOBILES, L. Renault, 15, Rue Gustave Sandoz, Billancourt (Seine), France.

The gas producer which is the subject of this invention has been designed so as to be more compact and so as to facilitate the renewal of the refractory lining, either wholly or in part when it has become worn or damaged by use. It comprises a casing within which and immediately adjacent thereto there is a refractory lining A for the furnace. A grate B is arranged at the lower part of the casing, which is closed at the bottom by a drop door. Above the casing there is a gas suction box C, which, in turn, carries a fuel reservoir D and charging hopper E. The refractory lining A, which constitutes one of the characteristics of the invention, instead of being made in a single piece as is generally done, is built up of a number of segmental blocks placed vertically within the casing. These segmental blocks are



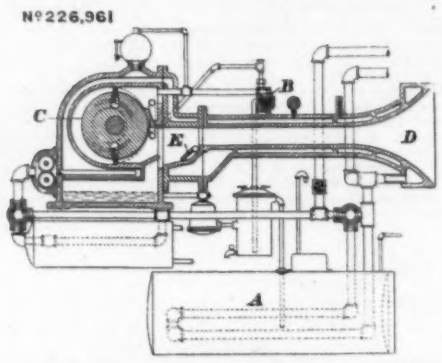
provided with conical ends, which abut at the top against the inclined bottom wall of the gas suction box C and at the bottom against an inclined angle iron ring F attached to the inside of the casing. The gas suction box C is secured to the casing by means of bolts R, whereby the segmental refractory blocks can be securely clamped in position between the two inclined surfaces at top and bottom, which abut against the conical ends of the blocks. In order to prevent fracture of the blocks and also to obtain tight joints, whilst at the same time preventing direct contact between the refractory blocks and the metal members of the producer, sheets of asbestos H from 5 mm. to 1 mm. thick, are interposed between the individual blocks, as well as between them and the casing and between their conical ends and the bottom of the gas suction box and the bottom ring F. The furnace is able to resist shocks, and is easy to repair in case of wear, since it suffices to slack back the nuts on the bolts R in order to be able to remove the whole furnace.—*January 8th*, 1925.

FURNACES.

226,961. December 18th, 1923.—OIL BURNERS, W. E. Shore, 242, Slosson-avenue, Castleton Corners, Staten Island, New York.

It appears, from the specification, that the inventor is aiming at the interchange of heat between the mouth of the burner and the incoming oil fuel, to such an extent that the oil may be fully vaporised, but yet carbonisation in the passages will be obviated. The oil is drawn from the tank A, and passing through the mixing valve B is delivered to the rotary atomiser C, which projects the mixture through the orifice D. This orifice is

jacketed, as shown, and a variety of connections is made with the jacket with the object of controlling the temperature according to the working conditions. Before lighting the fire, the flap

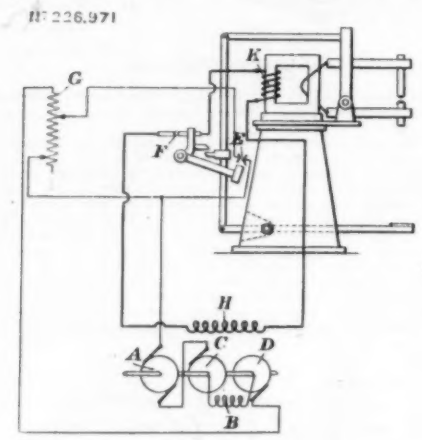


valve E is closed, and the fuel is by-passed round the atomiser until the churning action has elevated it to the ignition temperature.—*January 8th*, 1925.

MACHINE TOOLS AND SHOP APPLIANCES.

226,971. December 27th, 1923.—IMPROVEMENTS RELATING TO ELECTRIC RESISTANCE WELDING MACHINES, Cecil Allarton Hadley, of Island Bank-road, Inverness; and the Rose-street Foundry and Engineering Company, of 2, Rose-street, Inverness.

The characteristic feature in this invention resides in the provision of an auxiliary circuit so arranged that it is opened and closed simultaneously with or in close sequence with the main switch of an electric welding machine. When closed, the auxiliary circuit reduces the resistance in the circuit of the field windings of the alternator supplying current to the primary of a welding transformer. This resistance may be capable of being adjusted to such a value that the terminal voltage of the alternator is substantially constant, notwithstanding the change of

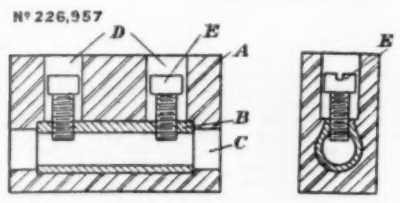


load resulting from the operation of the welding machine to which it is connected. When more than one welding machine is to be operated by the same alternator a separate switch and resistance unit is required for each machine, in order that the voltage may be maintained substantially constant. The dynamo A supplying current to the revolving field winding B of the alternator is connected to slip rings C and D. The construction is such that when the foot lever is depressed the switches E and F are closed and part of the resistance G is cut out while the circuit of the stator winding H is completed so that a current will flow through the primary winding K to the transformer. The resistance G is adjustable for the purpose of varying the current to the field winding when the welder is both in and out of use.—*January 8th*, 1925.

MISCELLANEOUS.

226,957. December 12th, 1923.—IMPROVEMENTS IN ELECTRIC CONNECTIONS, Francis Charles Raphael, of 35, Chase Green-avenue, Enfield, Middlesex; and W. T. Glover and Co., Limited, Trafford Park, Manchester.

The construction of the electrical connector described in this specification will be understood from the accompanying drawing.



A is a block of insulating material moulded round a brass tube B with a through hole C and two other holes D. The brass tube B is so shaped that it cannot rotate relatively to the insulator block. Threaded holes in the tube B register with the holes D. Binding or gripping screws are shown at E.—*January 8th*, 1925.

ILLUSTRATED TECHNICAL DICTIONARIES.—Many of our readers are familiar with the Schlomann-Oldenbourg illustrated technical dictionaries, and will be interested to hear that a British office has now been opened, and that Mr. H. I. Lewenz, M.I. Mech. E., M.I.E.E., 25, Victoria-street, has been appointed editor and manager for the British section, and will in future be responsible for the English terms and phrases contained in the dictionaries. We understand that to the fifteen volumes already published, one on weaving and woven materials and one on mining are in preparation, and that volumes on agricultural machinery, chemistry, gas engineering, &c., are in contemplation.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

INSTITUTION OF AERONAUTICAL ENGINEERS.—University College, Gower-street, London, W.C. 1. Lecture, "Photo-elastic Methods of Measuring Stress," by Professor E. G. Coker. 6.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—London Graduates' visit to the Lighting Service Bureau of the Electric Lamp Manufacturers' Association, 15, Savoy-street, London, W.C. 2. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Queen's Hotel, Coventry. Coventry Graduates' fourth annual dinner. 7.30 p.m.

INSTITUTION OF CIVIL ENGINEERS: BIRMINGHAM AND DISTRICT BRANCH.—Council Chamber, Council House, Birmingham. Annual joint meeting with the Institution of Mechanical Engineers, Midland Branch, and the Institution of Electrical Engineers, South Midland Centre. Subject, "Review of the Work of the First World Power Conference." 7 p.m.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND: STUDENTS' SECTION.—39, Elmbank-crescent, Glasgow. Paper, "Ship Design," by Professor P. A. Hillhouse. 8 p.m.

INSTITUTION OF ENGINEERING INSPECTION.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Paper, "The Radium Industry, its Development and Importance," by Major C. E. S. Phillips. 7.45 p.m.

INSTITUTION OF LOCOMOTIVE ENGINEERS.—The Engineers' Club, Coventry-street, London, W. 1. Annual dinner. 6.30 for 7 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, Westminster, London, S.W. 1. Annual general meeting. Further discussion on "Anti-friction Bearing Applications." 6 p.m.

INSTITUTION OF PRODUCTION ENGINEERS.—Society of Motor Manufacturers and Traders, 83, Pall Mall, London, S.W. 1. Paper, "Grinding Practice," by Mr. H. A. Dean. 7.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Lecturette, "Inverted Tooth Chain Drives," by Mr. J. M. Seddon. 7.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, Piccadilly, London, W. 1. Discourse, "Acquiring Muscular Skill," by Professor T. H. Pear. 9 p.m.

SATURDAY, FEBRUARY 21ST.

INSTITUTION OF ELECTRICAL ENGINEERS: SCOTTISH CENTRE.—The Grosvenor Restaurant, Gordon-street, Glasgow. Smoking concert. 7 p.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—North-Eastern District meeting at Blyth. 12.30 p.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Yorkshire District meeting at Hull. 11.15 a.m.

KEIGHLEY ASSOCIATION OF ENGINEERS.—Queen's Hotel, Keighley. Annual dinner. 5.45 p.m.

MONDAY, FEBRUARY 23RD.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. Cantor Lecture, "The Inner Structure of Alloys: II.," by Dr. W. Rosenhain. 8 p.m.

TUESDAY, FEBRUARY 24TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Broadgate Café, Coventry. Coventry Graduates' meeting. Paper, "The Testing of the Automobile," by Mr. R. N. Aveline. 7.15 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Society of Motor Manufacturers and Traders, 83, Pall Mall, London, S.W. 1. Informal meeting. Discussion on "Curious Breakdowns." 7 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, London, S.W. 1. Paper, "The Demolition of the Harbour and Defence Works of Heligoland," by Mr. L. H. Savile. 6 p.m.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND.—Rankine Hall, Elmbank-crescent, Glasgow. Paper, "The Latest Type of the Burmeister and Wain Marine Diesel Engine," by Mr. H. H. Blache. 7.30 p.m.

WEDNESDAY, FEBRUARY 25TH.

ENGINEERING GOLFING SOCIETY.—Institution of Civil Engineers, Great George-street, Westminster, London, S.W. 1. Annual general meeting. 12 noon.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Birmingham Graduates' visit to the works of the Midland Motor Cylinder Company, Limited, and the Birmingham Aluminium Castings Company, Limited, Smethwick.

INSTITUTION OF AUTOMOBILE ENGINEERS: NORTH OF ENGLAND CENTRE.—Engineering Theatre of the University, Liverpool. Paper, "Marine Motor Installation," by Mr. C. H Macmillan. 7 p.m.

INSTITUTION OF ENGINEERS-IN-CHARGE.—St. Bride Institute, Bride-lane, Fleet-street, London, E.C. 4. Discussion on "Responsibilities and Difficulties of the Engineer-in-Charge." 7.30 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS: GRADUATE SECTION.—The Mining Institute, Newcastle-upon-Tyne. "The Principle of Interference in Ship Waves and Ship Resistance," by Professor T. H. Havelock 7.15 p.m.

ROYAL MICROSCOPICAL SOCIETY: INDUSTRIAL APPLICATIONS SECTION.—20, Hanover-square, London, W. 1. Communications on "The Use of the Microscope in the Textile Industry" will be read and discussed. 7 for 7.30 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. "The Power of Internal Combustion Engines for Motor Cars." 8 p.m.

THURSDAY, FEBRUARY 26TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Training School of Vauxhall Motors, Limited, Luton. Luton Graduates' meeting. Paper, "The Balancing of Automobile Engine Crank Shafts," by Mr. W. B. Draper. 7.30 p.m.

INSTITUTION OF STRUCTURAL ENGINEERS.—Denison House, 296, Vauxhall Bridge-road, London, S.W. 1. Paper, "Reinforced Concrete Columns," by Mr. Edward Godfrey. 8 p.m.

FRIDAY, FEBRUARY 27TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Watergate House, Adelphi, London, W.C. 2. Graduates' meeting. Paper, "Why Pneumatic Tires?" by Mr. R. Marks. 7.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Lecturette, "A Treatise on Modern Lighting Practice," by Mr. E. Stroud. 7.30 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Literary and Philosophical Society, Newcastle-upon-Tyne. Paper, "Ultimate Possibilities of Steam Plant," by Professor A. L. Mellanby and Dr. W. Kerr. 7.30 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS: MIDDLESBROUGH BRANCH.—Graduate Section's visit to the works of Bolckow, Vaughan and Co., South Bank.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, Piccadilly, London, W. 1. Discourse, "Sugars from the Standpoint of the Organic Chemist," by Sir James Irvine. 9 p.m.

SATURDAY, FEBRUARY 28TH.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Graduate Section's visit to the works of the Tharsis Sulphur and Copper Company, Limited, Hebburn. 2.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, Piccadilly, London, W. 1. Lecture, "The Counting of the Atoms, I.," by Sir Ernest Rutherford. 3 p.m.

MONDAY, MARCH 2ND.

INSTITUTION OF MECHANICAL ENGINEERS: GRADUATES' SECTION.—Storey's Gate, Westminster, London, S.W. 1. Annual lecture. "A Visit to America," by Mr. W. H. Patchell. 7 p.m.

WEDNESDAY, MARCH 4TH.

NEWCOMEN SOCIETY.—Prince Henry's Room, 17, Fleet-street, London, E.C. 4. Paper, "Gun Handicraft," by Mr. C. E. Greener. 5.30 p.m.

THURSDAY, MARCH 5TH.

ROYAL AERONAUTICAL SOCIETY.—7, Albemarle-street, Piccadilly, London, W. 1. Paper, "Some Medical Aspects of Air Transport," by Lieutenant-Colonel C. B. Heald. 5.30 p.m.

FRIDAY, MARCH 6TH.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's Gate, Westminster, London, S.W. 1. Informal meeting. Discussion on "Pitfalls for Patentees." 7 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Lecturette, "How to Apply for a Job, and How Not to Do It," by Mr. E. Fianders Etchells. 7.30 p.m.

SATURDAY, MARCH 7TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Town Hall, Ealing, London, W. 5.—Joint meeting of the Eastern and South Midland Districts. 2.15 p.m.

MONDAY, MARCH 9TH.

CHADWICK PUBLIC LECTURE.—Inner Temple Hall, London. "The Necessity for Legislation with Regard to Smoke Abatement," by The Lord Newton. 8 p.m.

MONDAY, MARCH 16TH.

INSTITUTION OF STRUCTURAL ENGINEERS.—Criterion Restaurant, Piccadilly, London, W. 1. Annual dinner. 7 for 7.30 p.m

PERSONAL AND BUSINESS ANNOUNCEMENTS.

THOMPSON BROTHERS (Bilston), Limited, of Bilston, inform us that they have recently opened a London office at Aldwych House, Aldwych, London, W.C. 2.

EVRARD HAVENITH, of Antwerp, has appointed Messrs. H. Stockwell and Co., of 10, Corporation-street, Manchester, as his sole British selling agents in Great Britain.

W. P. BUTTERFIELD, Limited, of Shipley, has purchased the whole of the patterns and drawings of Concords, Limited, and is prepared to furnish duplicates of any machines purchased from the latter in the past, or to supply spares for same.

THE HOTCHKISS HYDRAULIC PROPELLER COMPANY, Limited, asks us to state that it has concluded an agreement whereby the exclusive manufacturing and selling rights of the Hotchkiss hydraulic propeller in Japan are taken over for a period by Mr. Tatsubo, the president of Chihaya Shokai, Limited, of Osaka, Japan.

CONTRACTS.

HOWDEN-LJUNGSTROM PREHEATERS (LAND), Limited, has delivered four large H.-L. air preheaters to Messrs. Caldwells Paper Mills, Inverkeithing. The total heating surface of these preheaters is 70,560 square feet; air will be supplied to the furnace at about 400 deg. Fah.

GOODWIN, BARSBY AND CO., Limited, of Leicester, have recently secured orders for plant from the South Shields Corporation, the Edmonton Urban District Council, the Southgate Urban District Council, Hull Corporation, the Board of Works Department to the Irish Free State, and the Bray Highway Urban District Council.

JOHN THOMPSON WATER TUBE BOILERS, Limited, Imperial House, Kingsway, has just received a repeat order from the Isle of Thanet Electric Supply Company, Limited, St. Peter's, Kent, for one of its vertical straight-tube type water-tube boilers, suitable for 40,000 lb. evaporation, 220 lb. working pressure, complete with superheater, brickwork, feed pumps, &c.

ED. BENNIS AND CO., Limited, have recently received a number of important orders for their products, including stokers and compressed air furnaces for Lancashire boilers, chain grate stokers for water-tube boilers and mechanical coal and ash handling machinery, among those giving the orders being five electricity undertakings, three collieries, seven textile or paper mills, and a railway company.

AN order has just been placed with Henry Simon, Limited, of Manchester, by the Stretford Urban District Council for the installation of a pneumatic coal intake and ash removal plant at its Trafford Park power station, Manchester. The contract includes the erection of a pneumatic coal-discharging plant, with a capacity of 30 tons per hour, band conveyors, coal bunkers, wagon tippler, weighbridge and a pneumatic ash-handling plant. The pneumatic plant will be utilised to discharge coal from barges arriving by canal, and will deliver to a receiver to be erected above an existing bunker.